REPORT

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KAMOA COPPER SA

Kamoa Copper Project Environmental Impact Study Update

PE n°12873, 13025 & 13026

Submitted to:
DPEM
Kamoa Copper SA

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Golder Associates

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TITLE I: COMPLIANCE WITH THE CONDITIONS FOR DEVELOPMENT OF THE ENVIRONMENTAL IMPACT STUDY AND THE PROJECT'S ENVIRONMENTAL MANAGEMENT PLAN

1.0 CHAPTER I: DEVELOPMENT OF THE ENVIRONMENTAL IMPACT STUDY AND THE PROJECT'S ENVIRONMENTAL MANAGEMENT PLAN

1.1 Examination of the guidelines on the Environmental Impact Study

The project developer (Kamoa Copper SA) and the Environmental Impact Study (EIS) consultant (Golder Associates DRCSARL) confirm that the Democratic Republic of Congo (DRC) Mining Regulations have been read and understood in the preparation of this EIS update for the Kamoa Copper Project.

1.2 Compliance with the conditions for development of the Environmental Impact Study and the project's Environmental Management Plan

In developing this EIS Update for the Kamoa Copper Project inclusive of Environmental Impact Assessment and Project Environmental Management Plan for the Project, conditions, substantive and technical environmental standards defined in Annex IX of Decree No. 038/2003 of 26 March 2003 have been followed.

1.3 Stages in the development of the Environmental Impact Study

During the preparation of this updated EIS containing an Environmental Impact Assessment and Environmental Management Plan of the Project, the framework of the Directive on Environmental Impact Assessment as set out in Annex IX of the Mining Regulations was followed; it includes eight major titles; namely:

- Awareness of the EIA directive when developing an EIS /EMPP;
- Presentation of the project;
- Analysis of the environmental system affected by the project;
- Analysis of the impacts of operations on the environment;
- Program of mitigation and rehabilitation measures;
- Detailed budget and financial plan for the mitigation and rehabilitation program and the financial guarantee for the environmental rehabilitation;
- Public consultation during the preparation of the EIS and sustainable development plan; and
- Conformity certification.

Under the DRC Mining Code, an EIS must be revised every 5 years. The first EIS for the project was completed in November 2011 and approved by the Department for the Protection of the Mining Environment (DPEM) in January 2012. Therefore this report presents the first update of the EIS for the Kamoa Copper Project.

The process of updating the EIS was as follows:

- A terms of reference reports setting out the scope of work for the EIS update was prepared and submitted to the DPEM for approval in October 2016;

- A draft EIS update was submitted to DPEM in January 2017;
- The draft EIS update was reviewed by an inter-ministerial committee in February 2017; and
- Based on the comments from the inter-ministerial committee the EIS was finalized and submitted to DPEM.

The public have been consulted throughout the EIS update process.

TITLE II: PRESENTATION OF MINING PROJECT

2.0 CHAPTER I: PROJECT IDENTIFICATION DETAILS

2.1 Company responsible for exploiting the mine

Kamoa Copper SA (Kamoa) a Democratic Republic of Congo (DRC) registered mining company, is the company responsible for the exploitation of the Kamoa deposit. Details of the company are provided in Table 1. Kamoa is jointly owned by Zijn Mining and Ivanhoe Mines with 20% owned by the DRC government.

Table 1: Name and Details of the Kamoa Copper Project Developer

Name of Project Developer	**Kamoa Copper SA**
Contact Details	2153, Avenue Club Nautique, Quartier Golf Les Battants, Commune/ Ville de Lubumbashi, Province du Haut-Katanga, République Démocratique du Congo
Business and National Identification Number	RCCM: 14-B-1683 ; ID. NAT. : 6-118-N37233J ; NIF: A0901048A
Owners	Kamoa Holding Limited (80 %) et Gouvernement de la RDC (20%)

2.2 Consultant Responsible for the Environmental Impact Study

Kamoa has appointed Golder Associates DRC SARL (Golder) to update the Environmental Impact Study (EIS). Golder is an independent company registered with the Department for the Protection of the Mining Environment (DPEM) and has no vested interest in the Project. Golder is an employee-owned, global company specialising in ground engineering and environmental services. From 160 offices worldwide, Golder's 6 000 employees work with clients who want to manage their environmental and engineering activities in a technically sound, economically viable and socially responsible manner.

Golder Associates are responsible for updating the EIS.

Table 2: Golder Associates DRC SARL Company Details

Golder Associates DRC SARL
17, Avenue Okito, Lubumbashi
RCCM: CD/TRICOM/L'SHI/RCCM: 14-B-1561
ID.NAT.: 6-83-N 85264 K
Numéro Impôt: A1006563
Haut-Katanga Province
Democratic Republic of Congo

2.3 Exploitation Right

The Project is primarily contained within Exploitation Permits 12873, 13025 and 13026 (formerly part of Exploration Permits 702, 703 and 705).

The Project has approximate dimensions of 45 km north-south by 20 km east-west, and covers an area of approximately 400 km² (Figure 1).

2.4 Name of the Project

The name of the Project is the Kamoa Copper Project.

2.5 Project location

The Project is located in the Lualaba Province in the south east of the DRC (Figure 2). The Project is located in Kolwezi District, Mutshatsha Territory and Lulua and Lufupa Sectors. Two Groupings are included in the concession area for the Project, Mwilu and Musokantanda, with Land Chief areas of Mpala and Muvunda respectively. The Kansoko mine is located within the Exploitation Permit No. 13026 whilst the Kakula mine is located within the scope of Exploitation Permit No. 13025 with an area that also extends into the perimeter of the Exploitation Permit No. 12873.The infrastructure of the two mines will be located both within the perimeters of the three Exploitation Permits Nos. 12873, 13025 and 13026 and outside, as is the case with the Kolwezi airport road - Kamoa Project site (Figure 2).

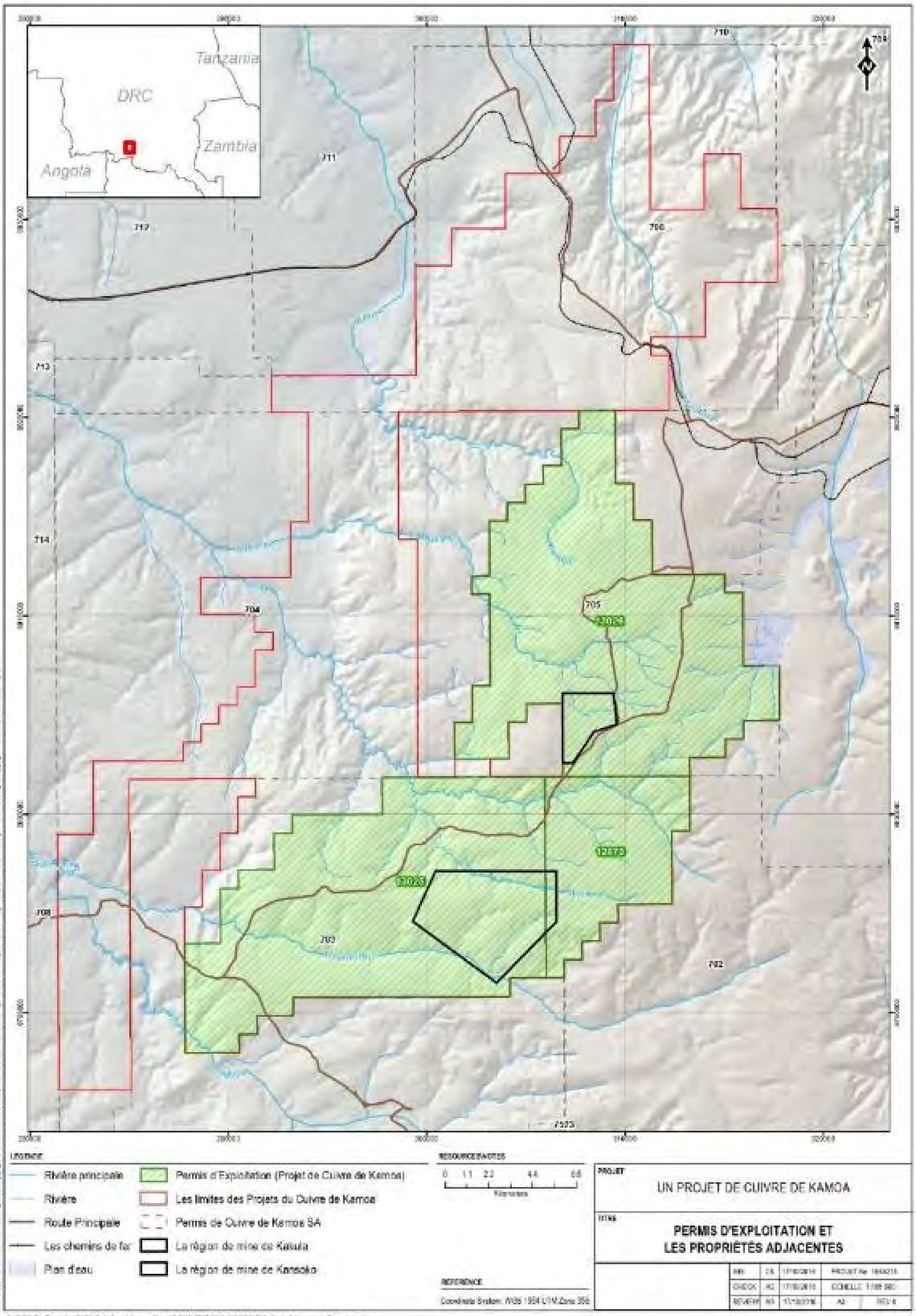


Figure 1: Kamoa Copper Project Exploitation Right and Adjacent Properties

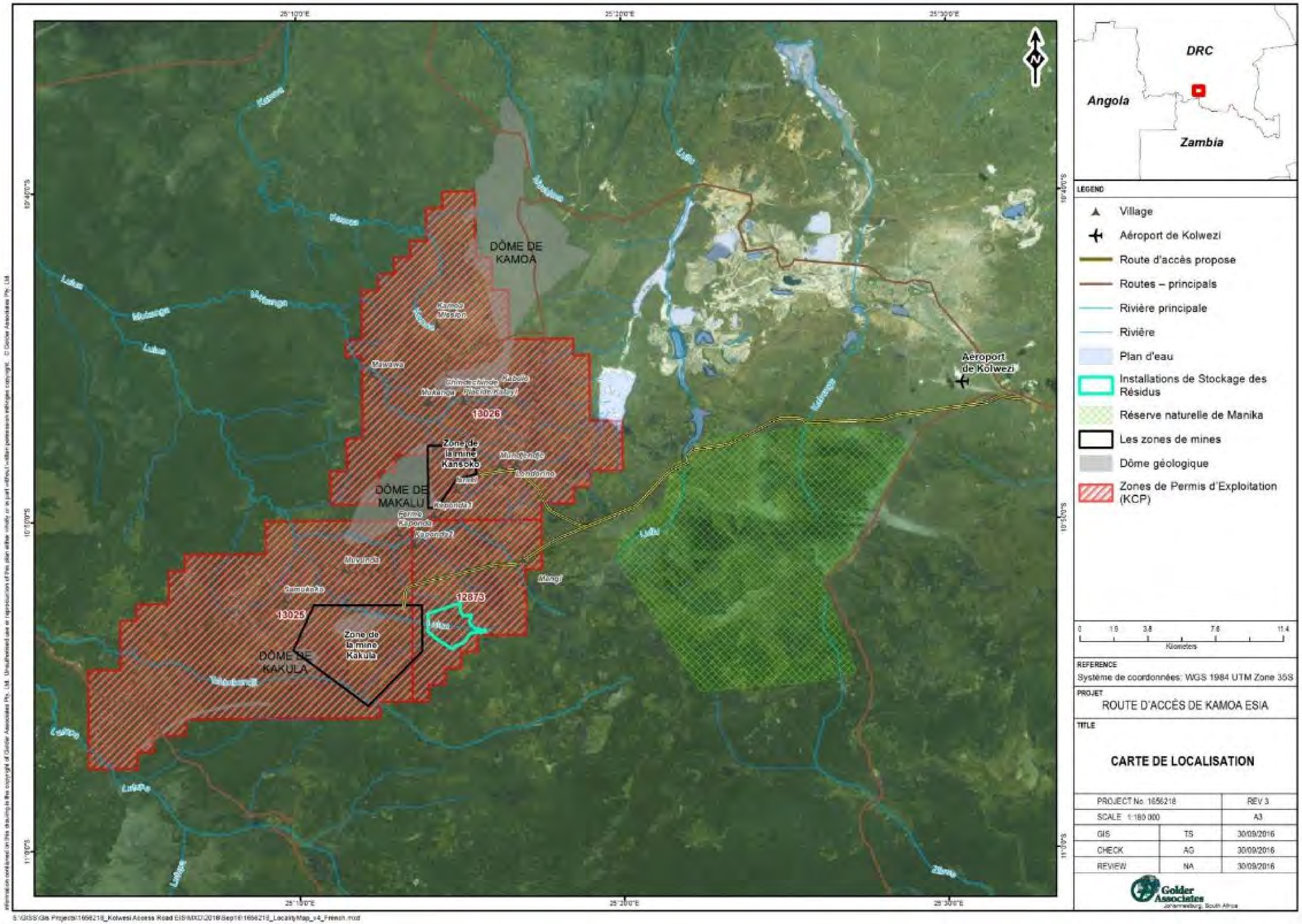


Figure 2: Project Locality

2.6 Land and Mining Rights on the Perimeter of the Exploitation Right

Kamoa Copper SA owns the exploitation rights to Exploitation Permits 12873, 13025 and 13026. The exploitation right allows Kamoa to carry out mining activities within the exploitation right in line with the approved feasibility study and EIS approved in 2012.

The following villages are located within the Exploitation Rights and have rights of enjoyment to the land:

- Benkeni;
- Chamadingi (Tshamadingi);
- Chindechinde;
- Cite Maseka;
- Cite Musoka (Dipuma);
- Ferme Kaponda;
- Israel;
- Kabulo;
- Kakunta;
- Kamisange;
- Kamoa Mission;
- Kangaso;
- Kaponda 1;
- Kaponda 2;
- Kavuma;
- Londorino;
- Mawawa;
- Mukanga;
- Mulemena;
- Mundjendje;
- Mupenda 1 & 2;
- Musulu;
- Muvunda;
- Ndjoni;
- Ndjosayi (Djosayi);
- Paulo;
- Placide/Katayi (Mukanga);
- Postolo/Sapalo;
- Quatre Jours (Muzeya);

- Samukoko;
- Sapatelo;
- Tshimbundji;
- Tshiwisha;
- Venance; and
- Wiri.

Environmental impact studies revealed that there are no land titles held within the scope of exploitation permits 12873, 13025 and 13026. Nevertheless, the populations living in the villages in the zone of influence of these Permits undertake agriculture and consume natural resources within teh permit areas. Whenever the company finds itself in need of a portion occupied by agricultural fields for drilling or access roads, contacts and arrangements are made with the occupants of the land for compensation in accordance with Article 281 of the Mining Code. Up to December 2016, 13,766.89 m^2 of fields were compensated for a total of 2,252,690 Congolese francs.

Table 3: Compensation

Annee	Location	Area Affected	Compensation CDF
2012	Kamoa central	1398.9	483100
2013	Kamoa central	1033.65	325600
2014	Kansoko	7195.49	583590
2015	Kansoko	567.45	112000
2016	Kansoko	459.9	158000
	Kakula	3111.5	1073500
TOTAL		**13.766,89**	**2.252.690**

Where there is a permanent need for land to be used for the project, studies and preliminary surveys are carried out with the relevant State services and in the presence of an independent nongovernmental organization in order to assess the area of fields and other property that the affected people may lose. Compensation is thus made after negotiation with the affected persons before the actual occupation of the land. To date, six rounds of crop compensation have been made according to the following table.

Table 4: Rounds of Compensation

Year	Place	Number of people affected	Area affected m^2	Total Compensation (CDF)
2014	Portail Kansoko	9	3170,277	967.000
2016	Mine Kansoko	68	70807,4813	54.087.721
2016	Elargissement Route	16	25238,66	16.180
2016	Ligne de force 11KVA	13	7715,7596	3.100.175
2016	Route Kakula	11	4937,214	2.243.889
2016	Portail Kakula	7	14394,9	10.285.548
TOTAL				**70.700.513**

The adjacent exploitation rights are shown in Figure 1.

3.0 CHAPTER II - PROJECT DESCRIPTION

3.1 Summary of the Project

The Kamoa Copper Project (the 'Project') will be a large-scale mining operation comparable to the large mines in the Lualaba Province (Kolwezi Mining District).

The Project will initially consist of two mining operations, the Kansoko Mine and the Kakula Mine. The current mine development plan is to produce 750,000 tonnes of copper concentrate per annum through the mining of a combined total of 8 million tonnes of copper sulphide ore. As mentioned above, the infrastructures of the two Kansoko and Kakula mines will be located both within the three Exploitation Permit Nos. 12873, 13025 and 13026 and outside, although the Kansoko (Kamoa) and Kakula deposits are located within the Exploitation Permits Nos. 13026 and 13025 (See Figure 4 – Kamoa Copper Project Layout Plan 1: 20,000).

3.1.1 Type and extent of the deposit to be exploited

The Kansoko and Kakula deposits have been independently ranked as the world's largest, undeveloped, high-grade copper discovery by international mining consultant Wood Mackenzie. They are both very large, near-surface, stratiform copper deposits. The current extent of the deposits to be mined cover an area of 50 km^2.

3.1.2 Planned exploitation work

Mining of copper will be done through underground mining methods at both mine sites. The ore will be transported to a processing plant at each mine site, by conveyor. The processing plants will include crushing and milling circuits (which grinds the ore to a fine powder), and a concentrator (which uses chemical and physical processes to separate the copper minerals from the ore to make a copper concentrate).

The Project will be developed as follows:

- **Construction (2016 to 2019) –** Construction of the Kansoko and Kakula mine infrastructure, (underground access declines and transport infrastructure), concentrators at the Kansoko and Kakula mine sites, power and water supply facilities, accommodation, offices and a single purpose built tailings storage facility (TSF); and
- **Operations (2019 to 2044**) – Initial underground operations at the Kansoko and Kakula mine sites with concentrator facilities which will process 8 million tonnes of ore per annum to produce 750,000 tonnes of concentrate per annum from the two operations.

3.1.3 Specific developments

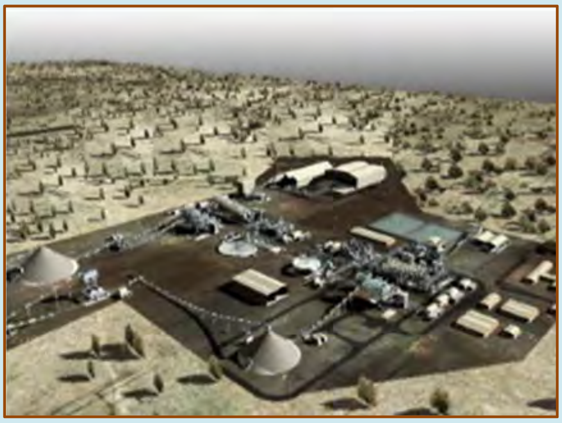
Since 2012 Kamoa has begun the development of a decline at the Kansoko mine site. Construction of the Kansoko mine and supporting infrastructure started in 2015. The following had been constructed by end-2016:

- Box cut and associated waste rock dump;
- First 500 m of twin access declines;
- De-watering boreholes for Kansoko mine and water supply boreholes (Total 12 boreholes);
- 120 kV Power line (20 km) to provide SNEL power to Kansoko mine (approved under a separate EIA);
- 120/11 kV Substation;
- 11 kV Power lines (6 km) to provide SNEL power to the camp;
- Temporary offices and workshop at the mine;
- Explosives magazine;
- Temporary fence around the box cut;
- Storm water settling pond;

- Diesel storage tank;
- Generators for back-up power;
- Permanent accommodation buildings (50 rooms) at existing camp;
- Temporary offices, stores and workshops at existing camp;
- Access road to Kakula; and
- Maize fields and fish ponds as community development projects.

The proposed additional infrastructure for the Project includes (Figure 4):

- Underground mining operations – the Kansoko and Kakula Mines, which will be accessed by decline shafts (tunnels that can be driven into by special mining vehicles). The decline shafts will be equipped with conveyors (to transport ore), ventilation and water pipelines (Kansoko will be expanded, wheras Kakula will be a new mine);
- Plant comprising concentrators at each mine site (inclusive of a crushing and milling circuit) with raw water and process water dams;
- One tailings storage facility (TSF) near Kakula mine;
- Mine-site perimeter fencing – a minimum of 12 km of fencing to be placed around the Kansoko Mine site, and 20 km of fencing to be placed around the Kakula Mine for safety reasons and hazard prevention;
- Waste rock dumps (WRD) are to be located next to each decline shaft (these will be minimal and most waste rock will be used for construction aggregate and TSF construction.500,000 tonnes at Kansoko and 200,000 tonnes at Kakula. A small amount (60,000 kt) of acid rock will be generated from the Kansoko decline shaft development) which will be specifically stored and encapsulated to minimise any risk;
- Transport infrastructure (access roads to the individual mine sites will be built from the Kolwezi Airport covering a distance of 36 km and 40 km to Kansoko and Kakula respectively), construction is expected to start in the first half of 2017;
- Water supply facilities (underground water and surface water options have been investigated as a source of water supply) – the Project will be a marginal net user in the first years and a net producer in the later years of the life-of-mine. All water to be used for mining and processing will come from de-watering the underground workings likely through surface de-watering boreholes. Approximately 17,000 m^3 per day will be pumped from each of the two mines (and boreholes). 70% of this will be used for processing and the rest will be discharged to the river after treatment if necessary;



Typical copper concentrator	Typical ventilation raise
 Typical tailings storage facility	 Kansoko decline shaft & portal

Figure 3: Typical Proposed Mine Infrastructure for the Kamoa Copper Project

- Power supply facilities –Kamoa Copper Project will be supplied on electricity energy in two stages following the consumption of the electric energy:

  1) Mine development: This step requires no more than 10 megawatts (MW). Given the electricity production shortfall at the National Electricity Company (SNEL), Ivanhoe Mines Energy DRC SARL (IVEN), an affiliate of Kamoa Copper SA, signed a pre-financing agreement with SNEL on 20 June 2012, for the urgent repair of Mwadingusha Group 1. The work was completed in September 2016 and the repaired Group 1 was put back into service and delivered 11 MW on the SNEL network. A 120 kV, 18 km, line was built from the RO-Kisenge line and a mobile facility 120/11 kV, 15/18 MVA, was installed at Kansoko. It is operational since 31 October 2016. It is planned to build a new 120 kV line, 13 km Kansoko-Kakula and a new 120 kV substation at Kakula.

  2) Mine Production: This phase will require up to 200 MW. In view of SNEL's electricity production shortfall, IVEN signed a financing agreement with SNEL on 21 March 2014. This agreement consists in rehabilitating and modernizing the hydroelectric power stations of Mwadingusha, Koni and Nzilo as well as their associated power grids. The construction of new lines and new high voltage substations is also planned under the same project. The Kansula and Kakula mines will be powered from a 220 kV, 35 km line, starting from the new 220 kV substation to be built next to the 220 kV Sicomines substation. Two new 220/11 kV substations will be built next to the Kansula and Kakula mine processing plants;

- Waste management, which includes hazardous, non-hazardous and medical waste and a sewerage treatment plant with water re-cycled for processing or used for irrigation and dust suppression. Non-hazardous material will be disposed of in landfill sites planned for the sites;

- Materials handling and storage, with explosives magazine;

- Offices, stores, workshops, fuel storage, change-house facilities, explosive workshops, accommodation, clinics, training centres will be constructed next to each mine decline shaft; and

- Farming projects (inside the fence), including maize fields and fish ponds.

Construction of the Project will be undertaken at the two mine sites. Commencing in 2016 and taking approximately three years, a peak of approximately 4 000 people inclusive of contractors will be employed across each mine site for the Project. During operations commencing in 2019, between 1 750 and 2 250 will be employed.

3.1.4 Exploitation methods to be used

The current mine development plan is to produce 750,000 tonnes of copper concentrate per annum through the mining of a combined total of 8 million tonnes of copper sulphide ore per annum from Kansoko and Kakula (4 million tonnes at each mine). The mining method to be adopted is mechanised underground mining.

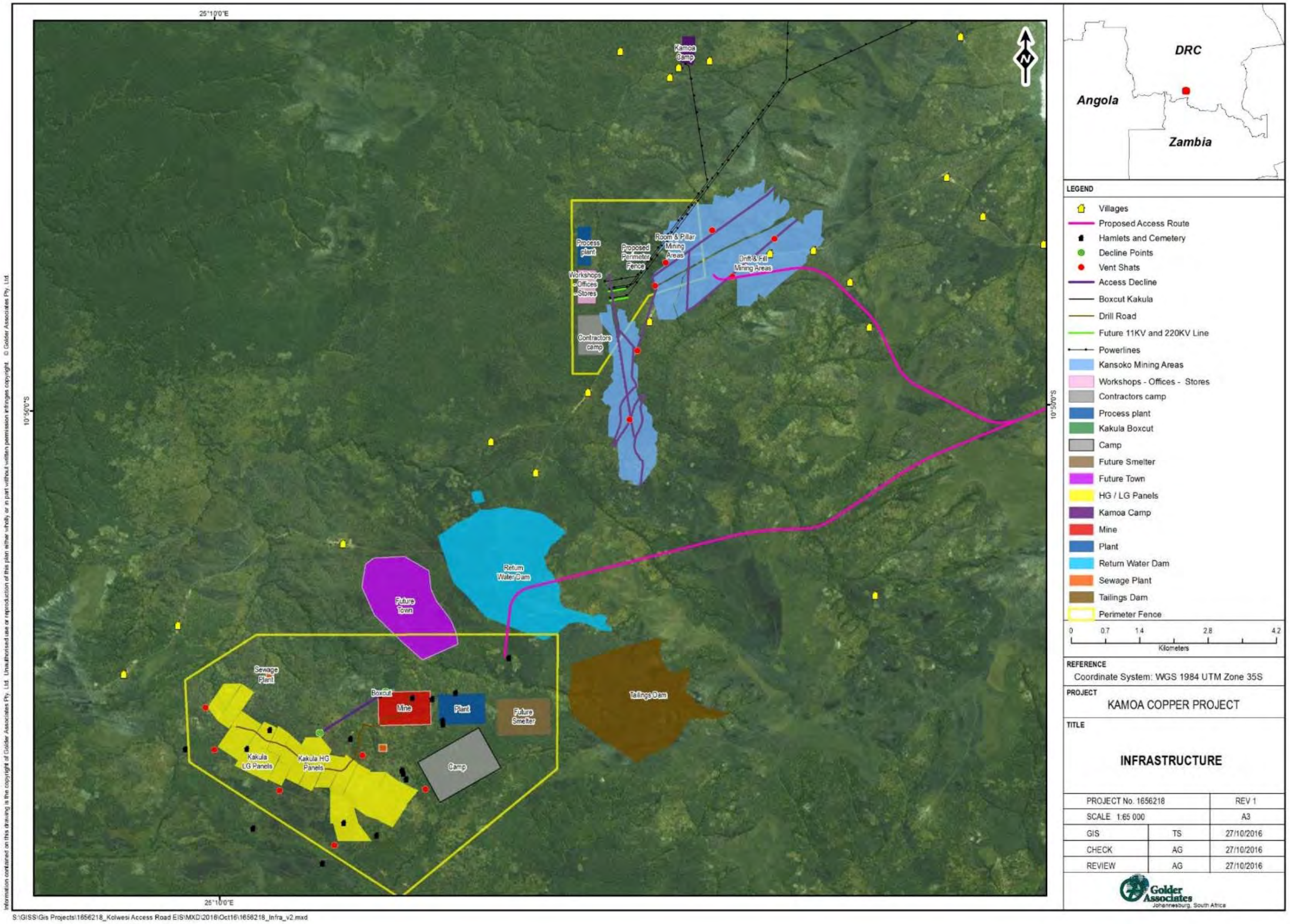


Figure 4: Location of the extraction workings

3.2 Mineralogy of the Deposit

The Kansoko and Kakula Deposits (which form part of the much larger Kamoa Deposit) are newly discovered, extensive, sediment-hosted stratiform copper deposits.

The metasedimentary rocks that host the Central African Copperbelt mineralisation form a sequence known as the Katanga Supergroup, comprising the Roan, Lower Kundelungu (Nguba), and Upper Kundelungu Groups. Copper mineralisation can occur at a number of stratigraphic levels within these Groups. The Kansoko and Kakula Deposits are hosted at the base of the Lower Kundelungu (Nguba) Group.

Mineral resource estimates have been completed by OreWin (OreWin, 2016) using the 2012 Canadian Institute of Mining and Metallurgy (CIMM) Definition Standards. The Mineral Resources identified are:

- Total Indicated Mineral Resource estimate for the Kamoa Deposit of 752 Million tonnes (Mt) grading 2.67% Copper (Cu) at a cut-off grade of 1 % Cu, over a minimum vertical mining thickness of 3m. An approximate cut-off grade of 1% was used for that subset of the Mineral Resource considered in the latest study (OreWin, 2016); and
- Total Inferred Mineral Resource estimate for the Kamoa Deposit of 185 Mt grading 2.08 % Cu at a cut-off grade of 1 %Cu, over a minimum vertical mining thickness of 3m (OreWin, 2016).

For the Kansoko and Kakula Deposits the latest Mineral Resource and Reserve Estimates are as follows:

Table 5: Kansoko Deposit - 2016 Mineral Reserve Statement

Reserve	Ore (Mt)	Cu (%)	Recovered Cu	
			(Mlb)	(Kt)
Probable Mineral Reserve	71.9	3.86	5 102	2 314
Mineral Reserve	71.9	3.85	5 102	2 314

Table 6: Kakula Deposit - 2016 Mineral Resource Estimate

Category	Tonnage (Mt)	Area (km2)	Copper (%)	True Thickness (m)	Contained Copper (Mlb)	Contained Copper (Kt)
Indicated	192	4.6	3.45	14.3	14 600	6 630
Inferred	101	3.3	2.74	10.3	6 100	2 763

- The surface area of the mine area to be developed is approximately 25 km^2 at Kansoko, with a similar footprint at Kakula. The remainder of Kamoa Copper SA's mining licences are being explored further to expand this resource; and
- The depth of the Kansoko and Kakula Deposits below surface varies from 100 m to 1 000 m. The more extensive Kamoa Deposit is still open down-dip and along strike. Ore at the Kansoko Mine will be exploited from a depth of 150 m from surface to approximately 1 000 m. At the Kakula Mine ore will be exploited from 230 m to 800 m depth.

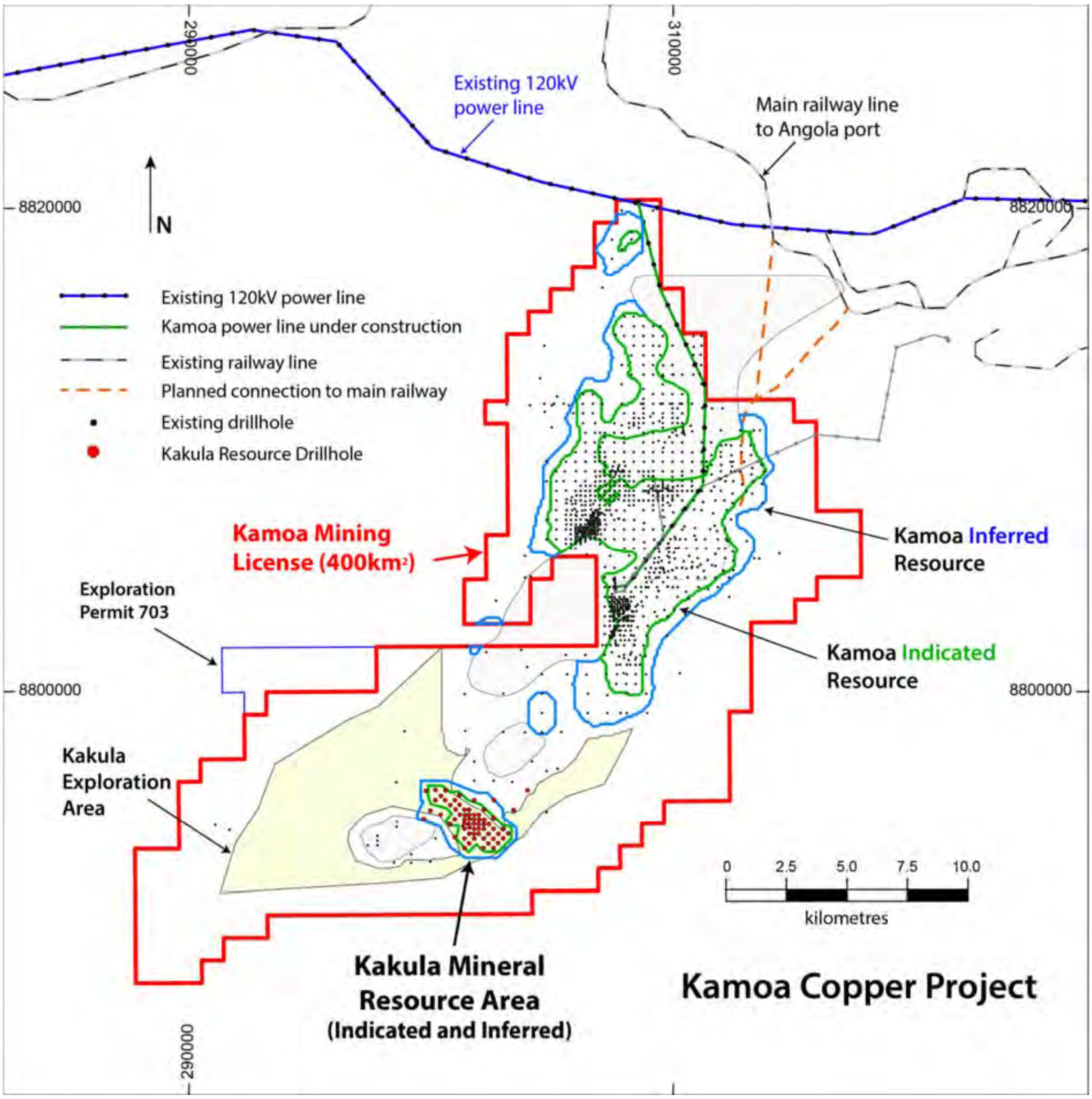


Figure 5: Resource map showing Copper grades

3.2.1 Geological Setting and Mineralisation

The Kansoko and Kakula Deposits are sedimentary hosted stratiform copper deposits that lie stratigraphically within the base of the Lower Kundelungu (Nguba) Group Diamictite which rest on the Mwashya footwall sandstones. The deposits have formed at a typical redox boundary with the Mwashya sandstone (R4.2) being the red beds (oxidised) and the Diamictite the greybeds (reduced). The deposit is outside of the fold and thrust region, within the foreland basin and is subsequently relatively undeformed and intact.

The lowermost clast-rich Diamictite (Ki1.1.1.1) unit generally hosts lower-grade (<0.5% Cu) mineralisation. Most of the higher-grade mineralisation occurs within the clast-poor (Ki1.1.1.3) unit, or in the sandstone and-siltstone (Ki1.1.1.2) interbeds that are locally present between the clast-rich (Ki1.1.1.1) and clast-poor (Ki1.1.1.3) diamictites. Copper mineralisation at the Kansoko and Kakula Deposits comprises three distinct styles: supergene, hypogene, and mixed mineralisation.

Near the surface adjacent to the Kamoa and Makalu Domes, the diamictites have been leached, resulting in localised zones of copper oxides and secondary copper sulphide enrichment down-dip.

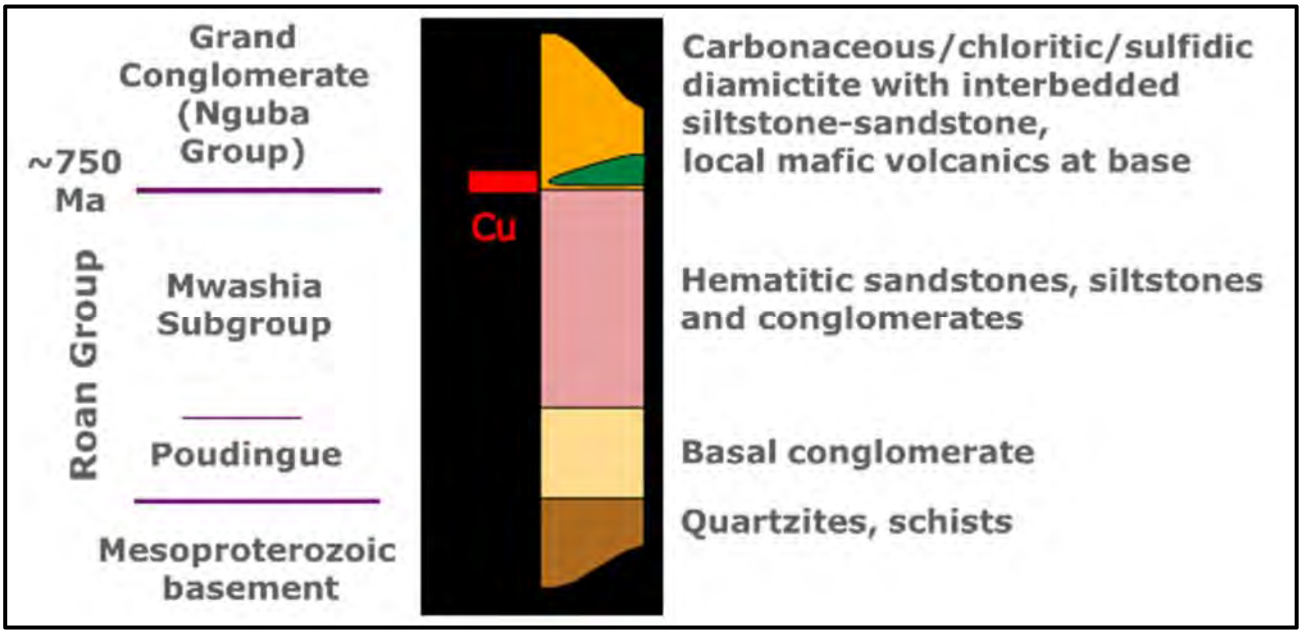


Figure 6: Simplified stratigraphic column of Kansoko and Kakula deposits

The Kansoko and Kakula deposits are almost entirely sulphide dominant (chalcopyrite, bornite, chalcocite), and zoned both vertically and laterally. No other economic mineral has been discovered in the Project area. The more extensive Kamoa Deposit forms a broad NE-SW trending anticline with an undulating hinge. Where undulations occur, exposed footwall rocks create “Domes” of barren rock at the surface, which will be used for the placement of infrastructure. These domes are known as the Kamoa, Makalu, Kakula and Kakula Northeast Domes.

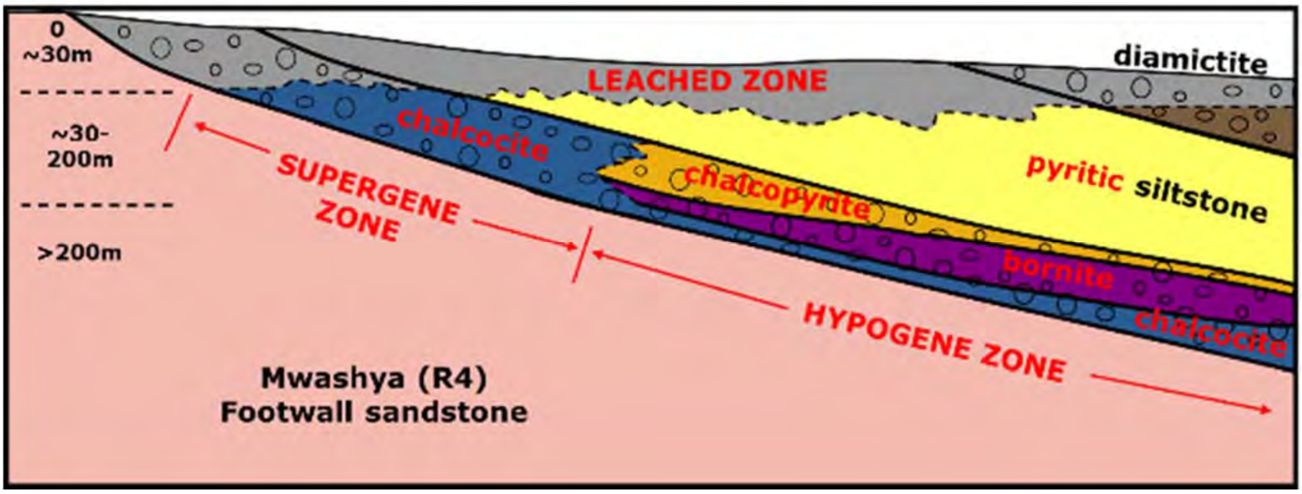


Figure 7: Schematic model of Kamoa mineralisation and zonation

Mineralisation is shallow, dipping between 0 to 20 degrees from approximately 20 m below surface to a current drilled depth of over 1 000 m. The deposits are more or less open in all directions and can easily be expanded with additional drilling. Thickness of the mineralisation ranges from 3 m to 18 m, averaging at around 7 m in thickness, generally with the highest grades at the base of the ore zone.

Mineralisation does not outcrop due to leaching by rainwater entering from the surface. This causes leaching immediately at shallow depths with often an enriched supergene zone at approximately 30 to 40 m. A mixed zone of hypogene mineralisation, leaching and supergene chalcocite +/- native copper is common in this area. A similar phenomenon can be noted at depth, where water has moved down through fractures or fault zones.

3.3 Ore Extraction

Mining at the Kansoko and Kakula Mines will take place by mechanised underground mining operations, the locations of which are illustrated in Figure 4.

3.3.1 Mean and Nominal Extraction Capacity

At 8 Mtpa, the recovered/diluted plant feed for the Project will be mined over approximately 25 years, excluding 18 months of pre-production development.

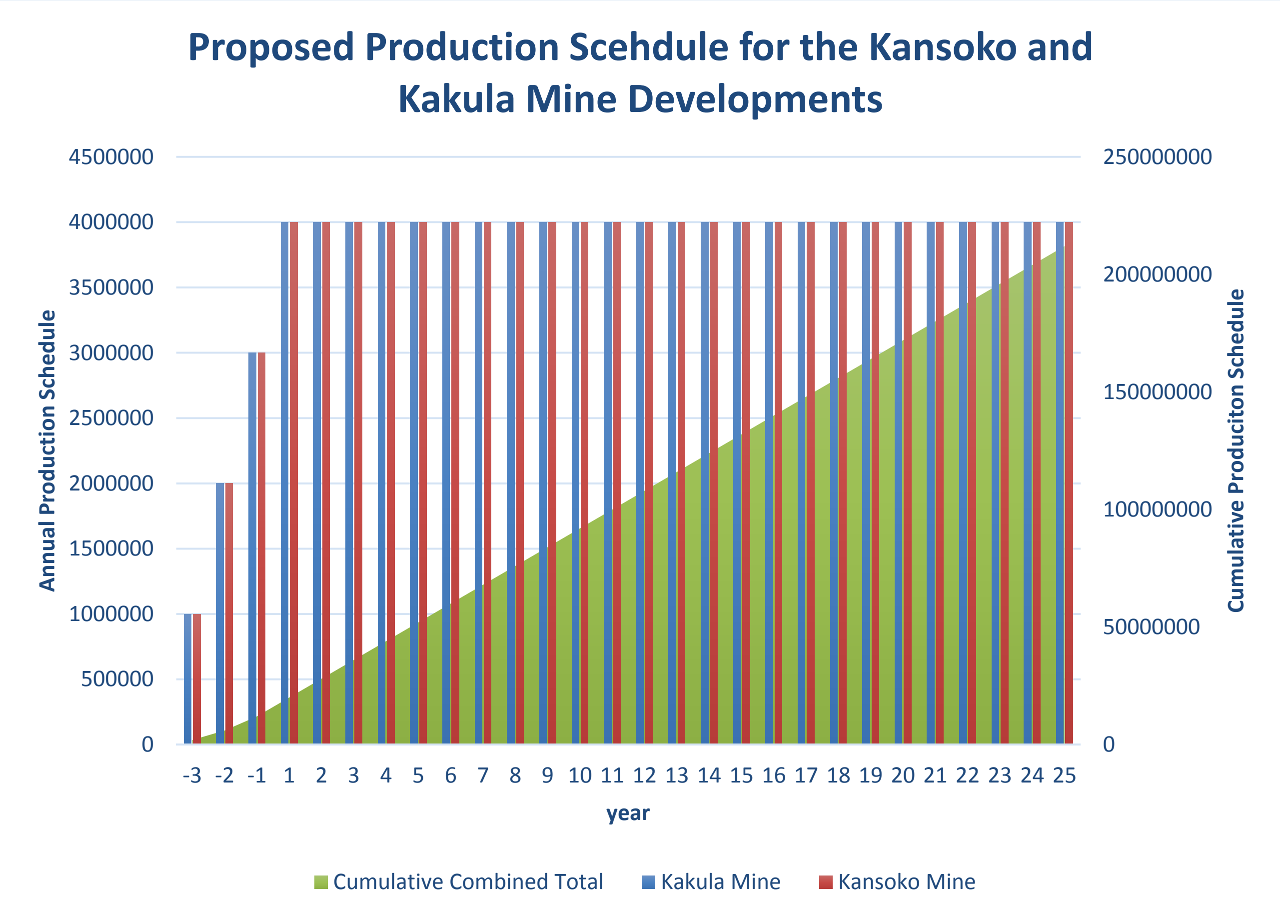


Figure 8: Underground production schedule

3.3.2 Location of the extraction workings transcribed onto the topographical map at a scale of 1:20,000

Refer to Figure 4.

3.3.3 Extraction methods being considered

The low dip and the flat, plate-like structure of the resource make it suitable for large-scale mechanised room-and-pillar mining.

Access to each of the underground areas will be via decline shafts. Once the access declines reach the mineralised zones, two parallel primary access drifts (5 m high by 5 m wide) will be developed. Stoping panels (80 m wide by 500 m long) will be laid out on either side of the primary access drifts so that a checkerboard of stoping panels is laid out in this section.

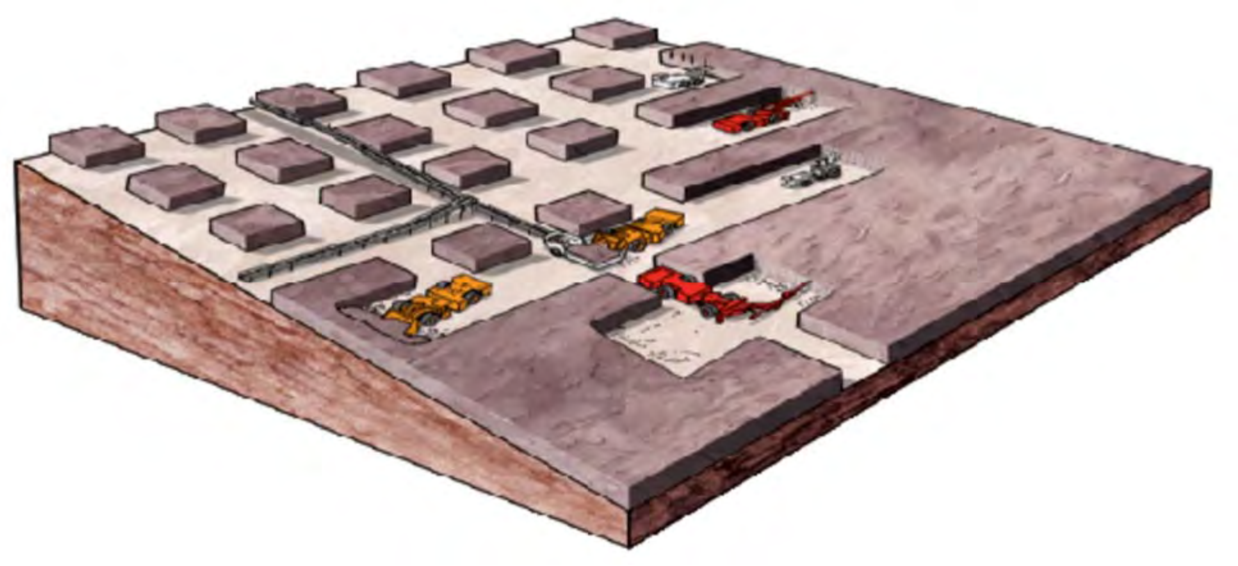


Figure 9: Example of room and pillar mining of a dipping resource (Figure by OreWin 2016)

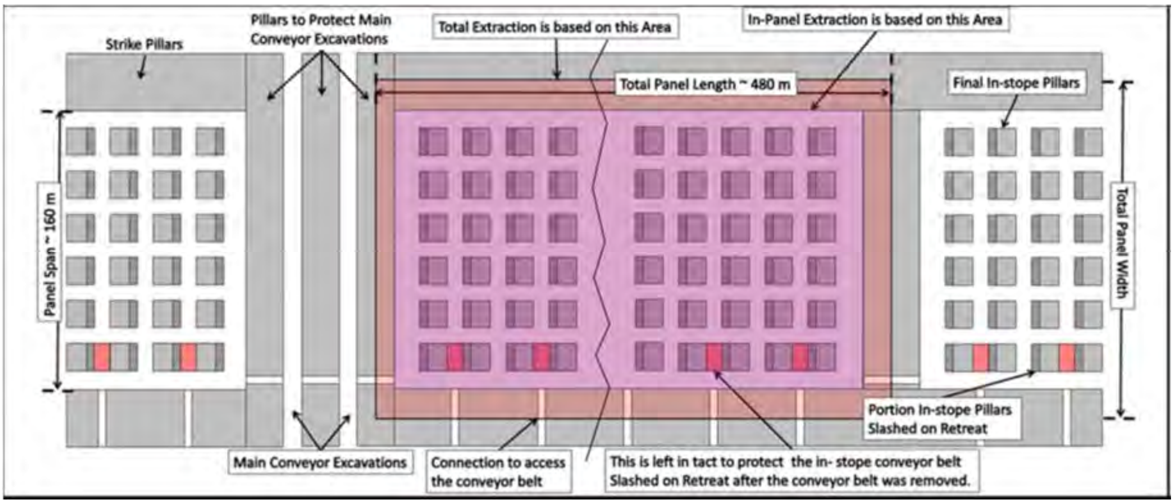


Figure 10: Typical layout of room and pillar stoping panel (Primary and Secondary) (Figure by OreWin 2016

3.3.4 Type and Number of Plant to be Utilised Including Explosives

The equipment requirements for each of the mine sites are split into two categories, fixed equipment and mobile equipment. The equipment requirements for each category are estimated at a conceptual level of accuracy and cover the major components required to meet the overall combined Project development and production schedules as well as meeting the equipment needs for the individual mining sections.

The type and number of plant and equipment that will be used during the operations of the Project are listed in Table 7 and Table 8 with examples provided in Figure 11. The ventilation requirement for operating this fleet of equipment exceeds the ventilation capacity of the access declines. Due to this constraint, the plan includes multiple fresh air and exhaust air raises in each mining section.

A detailed ventilation plan is under development to address the ventilation requirements in the different mining sections and to better define the intake and exhaust raise requirements.

Typical Underground Mining Plant

Typical Surface Development Plant

Typical Underground Mining Plant

Typical Infrastructure Plant

Figure 11: Typical proposed plant for the Kamoa Copper project

Table 7: Examples of Fixed Mine Equipment for each Mine Operation

Material Handling	**Water Handling Equipment**
Joy BF-38 (Feeder Breaker)	Electric submersible pumps with skid tanks
Ore Conveyor Belts approx. 20 km per mine	10 kW vertical spindle pumps
–	Warman C5 110 kW dirty water pumps
–	Multi-stage pumps
–	Generic (Potable Water Tank – 10,000 Litre/2,642 Gallon)
Shotcrete Plant	**Underground Shop**
Batch Plant and Equipment	UG Shop Equipment and Tools
–	Shop Bridge Crane – 25 t
Ventilation Equipment	Shop Bridge Crane – 10 t
8 x Drift Fans – Spendrup – 550 kW	–
UG Shop Fan 2 m dia. 75 kW	**Surface Diesel & Lubrication Storage**
	7 x 72 000L containerised diesel storage tanks
Refrigeration Plant and Bulk Air Cooler	10,000L, 2 x 6500L oil storage tanks + used oil tank

Material Handling	Water Handling Equipment
R134a centrifugal compressor	Grease Bins
Condenser Cooling Tower – Counter-flow type	–
Bulk Air Cooler with 90 kW draught fans	**Safety and Miscellaneous**
Cooling Tower	Shop Fire Door
–	Surface Office Equipment
Electrical Equipment	Hand Drills (Construction and Repair)
Main UG Substation	Portable Refuge Chambers for Contractors, then Owners
Main Surface Substation	Portable Refuge Chambers for Owner Personnel
Raise Main Vent Fan Substation	Mine Rescue Equipment
MCC for Pump Stations	Mine Rescue Gear Tester
MCC for Crews and Training	Miscellaneous Mine Rescue Supplies
UG Emulsion tanks	Portable Refuge Chambers for Owner Personnel
1 x 33 kV emergency generator	Sanitary Facility – 1 for 10 men
–	Sanitary Facility Service Unit for Boom Truck
HME Workshop	Cap Lamps
E. Shop Monorail Crane – 20 t	Cap Lamp Chargers – 30 position
E. Shop Jib Crane – 10 t	Self-Contained Self Rescuers – Initial Purchase
–	Miscellaneous First Aid Equipment
Air Compressors	Stench System
2 x 795CFM air compressors	Total Station Survey Equipment
–	Communications Equipment

Table 8: Mobile Equipment (Maximum Operating Quantities for the combined Mine Operations)

Mobile Equipment	Maximum Quantity
Development Fleet	
LHD	12
Twin Boom Drill Jumbo	8
Dump trucks (51 t)	8
Rockbolter	8
Cable Bolter	4
Explosive Charger	8
Personnel Transporters (28 people)	4
Utility Vehicle – 4 WD	6
Utility Vehicle - Explosives	4
Scissor Lift Truck – Construction	4
Road Grader	4
Shotcrete sprayers	4
Total	**74**

Mobile Equipment	Maximum Quantity
Mining Fleet	
LHD (17 t)	10
Twin Boom Drill Jumbo	12
Dump Trucks (51 t)	8
Rock bolter	12
Personnel Transporter (28 seater)	8
Explosives charger	10
Utility vehicle – 4 WD	8
Utility vehicle - explosives	4
Total	**72**

3.3.4.1 Blasting Plan

Underground Blasting Schedule

The drill and blast designs for the room-and-pillar stopes for both mine sites have been studied and are based on a blast hole pattern incorporating the results from the preliminary geotechnical studies. The general design assumes that the number of blast holes and the round length will achieve the desired fragmentation. The drill and blasting design parameters are presented in Table 9 for primary ramp development headings and Table 10 for production headings.

Two-boom jumbos will be utilised for all development and production drilling. Production blasting will be scheduled twice a day at shift change, development blasting can be scheduled at any time.

Table 9: Drill and Blast Design for Primary Ramps (6.5 m high by 5.5 m wide)

Parameter	Primary Drift
Drill hole Diameter	48.0 mm
Round Length	4.27 mm
Number of Holes in Round	99
Explosive Type	Emulsion
Powder Factor	2.92/kg cu.m

Table 10: Drill and Blast Design for Production Headings (5 m high by 8 m wide)

Parameter	Primary Drift
Drill hole Diameter	48.0 mm
Round Length	4.27 mm
Number of Holes in Round	111
Explosive Type	Emulsion
Powder Factor	2.94/kg cu.m

3.3.5 Volume of Overburden to be Moved and its Location

During the first years of mining at each mine site, or when suitable locations underground are not available, small amounts of waste may need to be stored in waste dumps located near the mine access portals. It can be noted that typically only box cuts, initial declines and vent shafts are in waste, this will amount to typically 500,000 m^3 at Kansoko and 200,000 m^3 at Kakula and is minimal.

A small amount (60,000 kt) of acid rock will be generated from the Kansoko decline shaft development) which will be specifically stored and encapsulated to minimise any risk.

Waste rock will be utilised as aggregate material (for road building and plant terracing) and for the construction of the purpose built TSF. All remaining waste rock will remain underground as random gob fill or for construction of ventilation control barriers.

3.4 Ore Processing Methods

The processing operations will consist of two 4 Mtpa concentrator plants (Figure 12) located at the Kansoko and Kakula Mine sites comprising of:

- Crushing - A two-stage crushing circuit which will feed the primary mill feed stockpile;
- Milling – consisting of primary and secondary ball mills operated in closed circuit with hydrocyclones and concentrate re-grind mills; and
- Flotation comprising:
  - Primary and secondary roughers with re-grind mills on the primary and secondary rougher concentrate;
  - Cleaner flotation circuit;
  - Concentrate thickener;
  - Tailings (concentrator waste) thickener and disposal; and
  - Reagent make-up and storage plant.

The concentrate will be dewatered using a combination of thickening and filters, bagged in a bagging plant as required, and stored in a purpose built storage facility (with two weeks' capacity) before transport and sale.

For each method outlined above, the type and number of plant and equipment to be used, the types of chemical agents, hydrocarbons and lubricants to be used, and the type and location of the planned processing installations is presented in section 3.6.

3.5 Pumping Water

3.5.1 Measures to Limit Dewatering

The estimated water demand for the Kansoko and Kakula Mine operations are given below in Table 11.

A system of boreholes are to be installed to dewater the decline shafts at each mine site. The water pumped from the boreholes will be clean water. The dewatering water is sufficient to meet both mines bulk supply of water requirements. The excess clean dewatering water is to be discharged to the local water course. Dewatering will be limited to to the extent of underground mining primarily to allow safe exctarion of the ore.

Table 11: Water demand for 2 x 4 Mt/a production

Mining Scenario		**4 Mtpa**	**8 Mtpa**
Description	**Units**		
Mining Water Requirement	m^3/day	160	320
Concentrator Water Requirement	m^3/day	4 800	9 600
Potable Water Requirement	m^3/day	140	280
TOTAL DAILY REQUIREMENT	m^3/day	5 100	10 200
TOTAL DAILY REQUIREMENT	ML/day	5.1	10.2

Potable water for the project will be sourced from groundwater resources. The bulk water supply may also be augmented in the future by groundwater inflow from the underground mining.

3.5.2 Main contaminants likely to be present in the Pumping Water

The results of the chemical analyses collected from the groundwater exploration/test boreholes indicates that the general groundwater is characterised by low to very low Total Dissolved Solids (TDS) ranging from <3 mg/l to 38 mg/l (Table 12). The water pumped is likely to have very little change in quality due to the use boreholes for dewatering. However, groundwater may still be vulnerable to water quality changes due to mining activities such as blasting and any spills of oil of fuel as well as potential acd mine drainage. Therefore the main contaminants to be tracked are pH, TDS, Nitrates, Oil and Grease and sulphates.

Table 12: Water quality testwork results

Determinant	Units	Avg.
pH		5.77
Conductivity	mS/cm	1.05
TDS	mg/L	40.0
Calcium hardness $CaCO_3$	mg/L	4.74
Magnesium hardness $CaCO_3$	mg/L	2.64
Total hardness $CaCO_3$	mg/L	7.38
Suspended solids	mg/L	20.0
M-alkalinity $CaCO_3$	mg/L	0.60
P-alkalinity $CaCO_3$	mg/L	6.40
Cl	mg/L	0.37
NO_2	mg/L	0.20
NO_3	mg/L	0.30
PO_4	mg/L	0.80
SO_4	mg/L	1.94

3.5.3 Mean Daily volume and Flow Rates of the Pumping Water

Studies are ongoing to determine the volumes of groundwater likely to be encountered in the underground mine workings. The current planned dewatering rate for each mine operation is 9 504 m^3/d.

During the initial permanent arrangement and the permanent life-of-mine scenario the annual water balance indicates that the mine will be a minimal net user during the development stages and a minimal net producer during the permanent life-of-mine arrangement.

Based on the available information, it is estimated (for each mine site) that the average water volume-in will be 171,174 m^3/d and the average water volume-out will be 171,175 m^3/d. The water requirements are based on the assumption that 35% of the tailings water is returned. This water will have to be treated to the appropriate level for re-use on the mines. All TSF water will be recycled to the processing plants; there will be no discharge from the TSF.

3.5.4 Constituent parts of the system to dewater and keep the workings dry

A system of boreholes are to be installed to dewater the decline shafts at each mine site. The boreholes will be sunk in series adjacent to each shaft and connected by HDPE piping and booster pumps to transfer the water to the plant.

3.5.5 Use of the pumping water

Clean excess water from mine dewatering boreholes from the Kansoko and Kakula mines not required for plant operations will be discharged to the Lulua and Kakula rivers respectively.

3.5.6 Pumping water evacuation site

The evacuation site has not yet been identified. The site determined will be in close vicinity to the dewatering network to minimise piping and will be designed to minimse erosion.

3.6 Processing Plant

Details of the processing plant are provided in the following sections.

3.6.1 Ore Receiving, Conveying, Stockpiling and Crushing

Location of the ore processing plant

The locations of the ore processing plants are presented in Figure 2. The exact location for the processing plant at Kakula has not yet been decided, however the plant at Kansoko will be directly adjacent to the box cut as illustratated in Figure 12.

Plans and specification

See Figure 12.

Stages of the ore processing process

Mineralised material from both the Kansoko and Kakula underground developments will be conveyed to the surface via an incline conveyor at each portal. A slewing stacker will provide the facility to discharge run of mine (ROM) material onto a pad (emergency stockpile) or directly onto a conveyor system for transfer of the material to the concentrator plant ROM stockpiles.

The emergency stockpiles at each portal are required to allow for continuous mining operations in the event of non-availability of downstream equipment up to the ROM stockpiles. A maximum emergency ROM stockpile capacity of 16 hours is envisaged at each portal. Material from these emergency ROM stockpiles can be reclaimed and reintroduced onto the conveyor systems by means of front-end loaders. If additional storage is required, material can be hauled from the emergency stockpiles to the strategic stockpile area at each portal.

Strategic stockpiles of around 1.0 to 1.5 million tonnes (Mt) are required near each mine portal, to provide for early mining production that will commence 12 to 18 months before the concentrators are commissioned. Approximately 2.0 to 3.0 Mt of combined ROM material is to be stored at the Kansoko and Kakula Mine portals as strategic stockpiles. Feed systems are allowed for on the ROM conveyors to load these stockpile materials when they are required.

A ROM conveying system is to be installed from the Kansoko decline portal, up to the Kansoko ROM stockpile for the 4 Mtpa concentrator. In addition, a ROM conveying system is to be installed from the Kakula decline portal, up to the Kakula ROM stockpile for the 4 Mtpa concentrator at this site. These conveyor systems are sized to handle the full production from the Kansoko and Kakula developments respectively.

Three variable speed apron feeders will be available to recover ore from the stockpiles and feed to the primary crusher. ROM ore will be fed onto the 50 mm heavy duty primary screens at each plant site from which the oversize is sent to primary crushing and the undersize direct to secondary crushing.

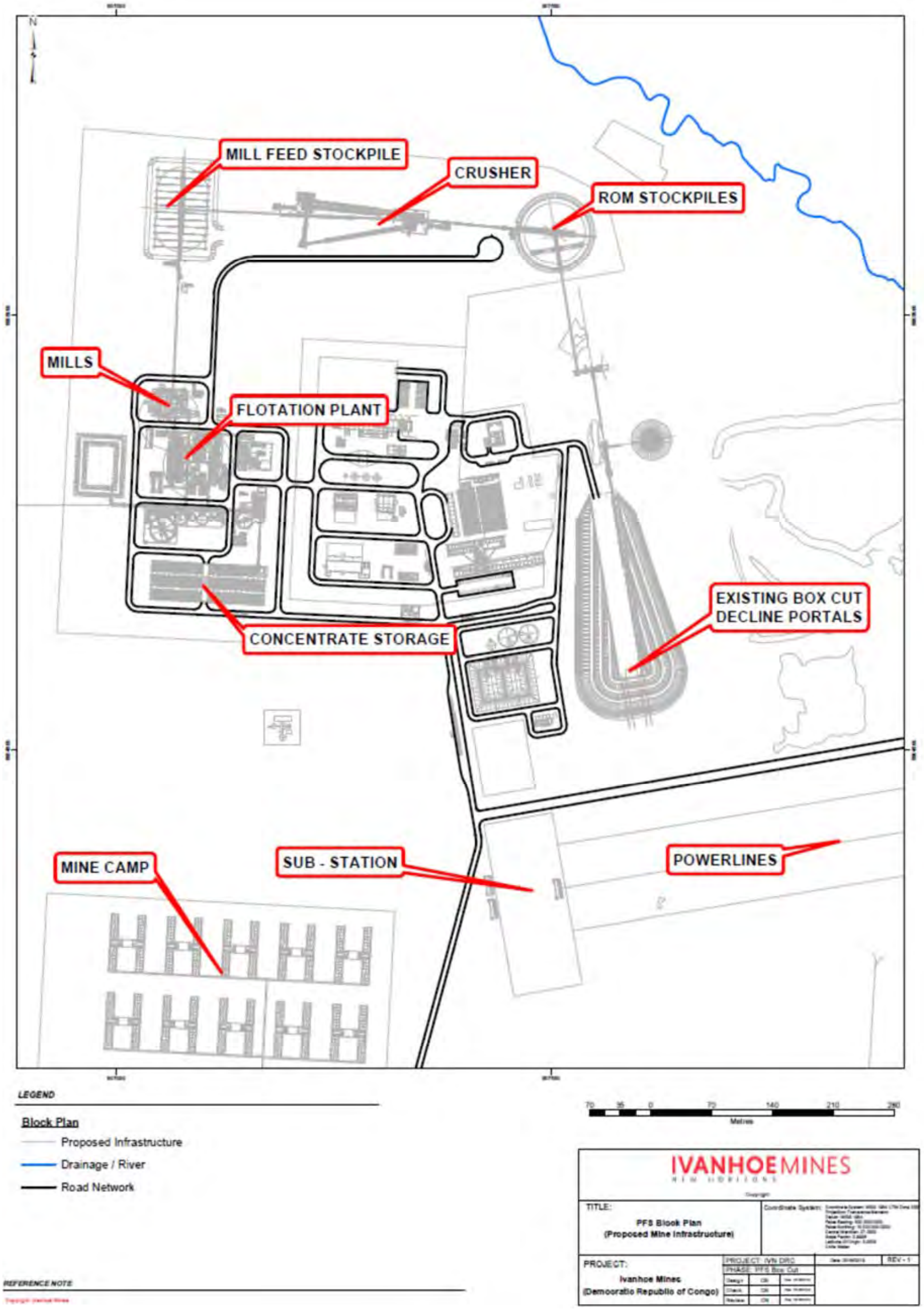


Figure 12: Conceptual site infrastructure layout plan

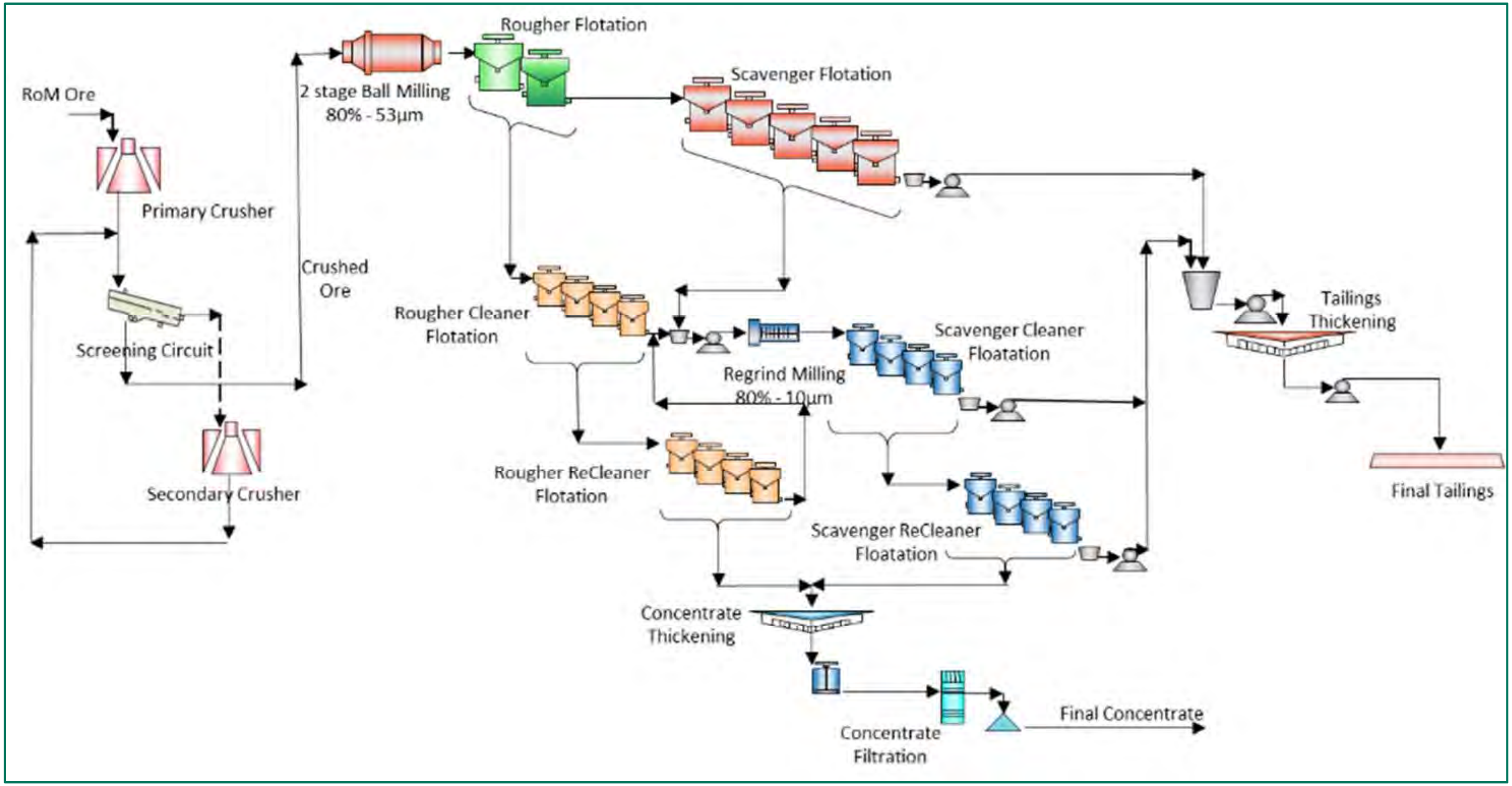


Figure 13: Process flow diagram

3.6.1.1 Primary and Secondary Milling

Primary Milling

Crushed ore (-12 mm) will be fed into ball mills (each mine operation will have one overflow mill, 22 ft. Ø x 36 ft. EGL, for each 4 Mtpa concentrator).The primary ball mill is designed to conduct the coarse grind component only and will reduce the ore to approximately 75 µm P80.

The mills will operate in a closed circuit with hydrocyclones with a 250% nominal recirculating load (design 300%). The cyclone overflow (75 µm P80) gravitates to the primary rougher feed surge tanks at a slurry density of about 30% solids, equivalent to 1.3 tonnes per cubic metre. Dispersant will be added to the primary ball mill feeds.

Secondary Milling

Primary rougher flotation tails will be pumped to the secondary ball mills (each mine operation will have one overflow mill, 22 ft. Ø x 36 ft. EGL, 8.8 MW installed power for each 4 Mtpa concentrator or the 4 Mtpa concentrator).

The mills will operate in a closed circuit with hydrocyclones with a 250% nominal recirculating load (design 300%). The cyclone overflow (53 µm P80) gravitates to the scavenger feed surge tank at a slurry density of 30% solids, which is equivalent to 1.3 tonnes per cubic metre.

Primary and Secondary Milling Media

The media used for all the mills will be high chrome steel but the secondary mill balls will be smaller diameter than the primary mill balls. Steel balls will be added to both mills using a dedicated ball kibble, magnet, and hoist arrangement. This will be a semi-automated operation and steel balls will be added as required.

Spillage from the respective milling circuits will report to the corresponding mill discharge sumps. Scats from all mills, typically worn media and a small amount of oversize rock particles, are discharged into respective kibbles for circuit removal.

3.6.2 Mean Processing Capacity

Concentrator

The proposed concentrators for each mine site are 4Mt per annum capacity with an MF2 circuit configuration. For the Kansoko Mine, the plant copper feed grade (LoM average) is 3.8% and is designed to achieve a combined 86% recovery at 35.0% Cu concentrate grade. For the Kakula Mine, the plant copper feed grade (LoM average) is 6.5% and is designed to achieve a combined 86% recovery at 53% Cu concentrate grade.

The concentrator at each mine site will comprise of:

- A flotation circuit consisting of roughers and scavengers with a re-grind mill between the rougher and scavenger stages. Various chemical reagents are added to the milled ore to cause the copper bearing minerals to fix to air bubbles in the flotation cells which float to the surface and are removed to form copper concentrate;
- Concentrator regrind mills consisting of a rougher concentrate regrind mill and a scavenger concentrate regrind mill;
- A cleaner circuit consisting of cleaners, scavenger cleaners and re-cleaners. The cleaner circuit incorporates two concentrate regrind stages; and
- Concentrate thickening circuit consisting of a concentrate Thickener and Filter to produce a final concentrate. The concentrator will include a concentrate bagging facility.

Waste generated from the concentrator in the form of tailings derived from the scavenger tails and multiple non-float streams from the scavenger cleaner circuit will report to the final tails Thickener before being pumped to the TSF for disposal.

3.6.2.1 Quantitative Routing of the Soid, Liquid and Gaseous Phases

Provision will be made for the mixing and supply of the necessary reagents for flotation at each mine site. Individual peristaltic pumps and piping will be installed for each addition point of each reagent.

Raw water from local boreholes or surface sources (to be determined) will be collected and stored in a raw water dam at each mine site. Filtration and treatment plants produce a range of water qualities as required for potable water, gland seal water, granulation water and process water usage. Distribution systems for each water type are included, ensuring delivery of sufficient quantity at the required pressure.

Dedicated blowers will supply manifold air for the flotation cells at each mine site.

Compressed air will be supplied and distributed, at each mine site, for the use of general plant requirements and filter presses. A dried air (dew point <0°C) supply will be available for air actuated instruments and valves.

3.6.2.2 List and Technical Specifications

A summary of equipment and inputs that will be utilised at each concentrator during operations is presented in Table 13 and Table 14.

Table 13: 4 Mtpa Concentrator Equipment Requirements Summary Table (for each mine site)

Item	Description	Size/Capacity	No. Required + standby	Power Installed (kW) per unit
Compressors	General & instrument air	2 994 m^3/h @ 7.5 bar	2	500
	HP filter air	756 m^3/h @ 16 bar 1,566 m^3/h @ 10 bar	1 1	110 400
Water treatment	Filtration	50 m^3/h	1	-
	Treatment (potable)	20 m^3/h	1	5.5
Crushers	Primary cone	CS660	1	315
	Secondary cone	CH865	2	500
Screens	Primary	2.4 m x 4.27 m	1	45
	Secondary	3.1 m x 6.1 m	3	55
Mills	Primary	22 ft x 36 ft	1	8 800
	Secondary	22 ft x 36 ft	1	8 800
	Concentrate regrind	IsaMill M10 0000	2	3 000
Cyclones	Primary cluster	750 mm diameter	3 + 1	500
	Secondary cluster	420 mm diameter	7 + 1	355
	Concentrate regrind cluster	100 mm diameter	18 + 4	75
Blowers	Flotation cells	33 900 Nm^3/h @ 150kPa	2 + 1	110
Flotation cells (includes agitators)	Rougher	200 m^3	2	250
	Scavenger	200 m^3	9	250
	Rougher cleaner	30 m^3	4	75
	Rougher recleaner	20 m^3	5	55
	Scavenger cleaner	100 m^3	9	225
	Scavenger recleaner	20 m^3	4	55
Thickeners	Concentrate	15 m dia	1	11

	Tailings	30 m dia	1	18
Filters	Concentrate	Larox PF 132/144	2	18.5
Pumps	Tailings	426 m^3/h	4 + 4	250
Total		1 x 4 Mta concentrator		35 to 40 MW
Total		2 x 4 Mta concentrator		70 to 80 MW

Table 14: Projected Concentrator Water, Power and Consumables

Item	Description	Annual Requirement – 4 Mtpa	Annual Requirement – 2 x 4 Mtpa (8 Mtpa)
Power	Electric	280 GWh	560 GWh
Water	Raw make-up	1 706 Mm^3	2 560 Mm^3
Reagents	Frother (Senfroth)	380 t	760 t
	Collector (SIBX)	624 t	1248 t
	Promoter (Cytec 3477)	112 t	224 t
	Flocculant (Tailings and Concentrate) (Magnafloc 10)	140 t	280 t
Consumables	Grinding media (75 mm steel balls)	3 920 t	7 840 t
	Grinding media (35 mm steel balls)	7 920 t	15 840 t
	Grinding media (2 mm cermaic)	548 t	1 096 t

3.6.2.3 Plans and Spcification for the Structures, Equipment and Instalations for storing Chemicals

Materials will be stored in dedicated storage facilities as per the relevant Materials Safety Data Sheets (MSDS) (see APPENDIX B). Plans and specifications are currently in the detailed design phase.

3.6.3 Cyanide Budget

No Cyandie will be used for mineral processing at Kamoa.

3.6.4 Planned preventive and emergency measures.

Kamoa are currently in the process of developing a specific emergency preparedness and response plan. The plan will contain the following information:

- Identified areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected Communities and periodic training to ensure effective response;
- Provisions for assisting and collaborating with the potentially Affected Communities and the local government agencies in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to ensure effective response;
- Emergency preparedness and response activities, resources, and responsibilities, and mechanisms to provide information to potentially Affected Community and relevant government agencies; and

- For both workers and communities it will provide details on:
  - Specific emergency response procedures;
  - Trained emergency response teams;
  - Emergency contacts and communication systems/protocols (including communication with Affected Communities when necessary);
  - Procedures for interaction with government authorities (emergency, health, environmental authorities);
  - Permanently stationed emergency equipment and facilities (e.g., first aid stations, firefighting equipment, spill response equipment, personal protection equipment for the emergency response teams);
  - Protocols for the use of the emergency equipment and facilities;
  - Identification of evacuation routes and muster points;
  - Emergency drills and their periodicity based on assigned emergency levels or tiers; and
  - Decontamination procedures and means to proceed with urgent remedial measures to contain, limit and reduce pollution within the physical boundaries of the project property and assets to the extent possible.

3.7 Final Effluent

3.7.1 Methods for discharge

Clean excess water from mine dewatering boreholes from the Kansoko and Kakula mines not required for plant operations will be discharged to the Lulua and Kakula rivers respectively via settling dams prior to discharge. Dirty mine service water from underground operations will be reused in the operation. Mine Services Water will be stored in a surface dam (2,500 m^3 capacity for each mine) and any excess gravity fed back underground.

The plants are designed as zero discharge facilities with water reused in the process. Storm water controls will be developed to separate clean and dirty water and containment facilities (impervious flooring and bunding with return pumps for liquid effluent) established to contain any spills from reagents stores and tanks.

Waste water from the plant will be discharged with the tailings to the TSF, with supernatant returned to the process as indicated in section 3.8. It is anticipated that of the reagents used 183 g/t of SIBX, 30 g/t of SF 522 and 30 g/t of floculant will likely report to the TSF in this waste water and in the tailings. The TSF is designed as a zero discharge facility able to contain the 1:100 year storm event and therefore no surface effluent discharge for the TSF is expected (some discharge is expected through seepage).

3.7.2 Location of discharge points

As the plants are designed as zero discharge facilities there are no specific discharge points. Excess clean underground water will be discharged into the Lulua River (from Kansoko) and Kakula River (from Kakula). The exact design and location are being defined through ongoing mine planning but are aniticipated be located as illustrated in Figure 14 andFigure 15.

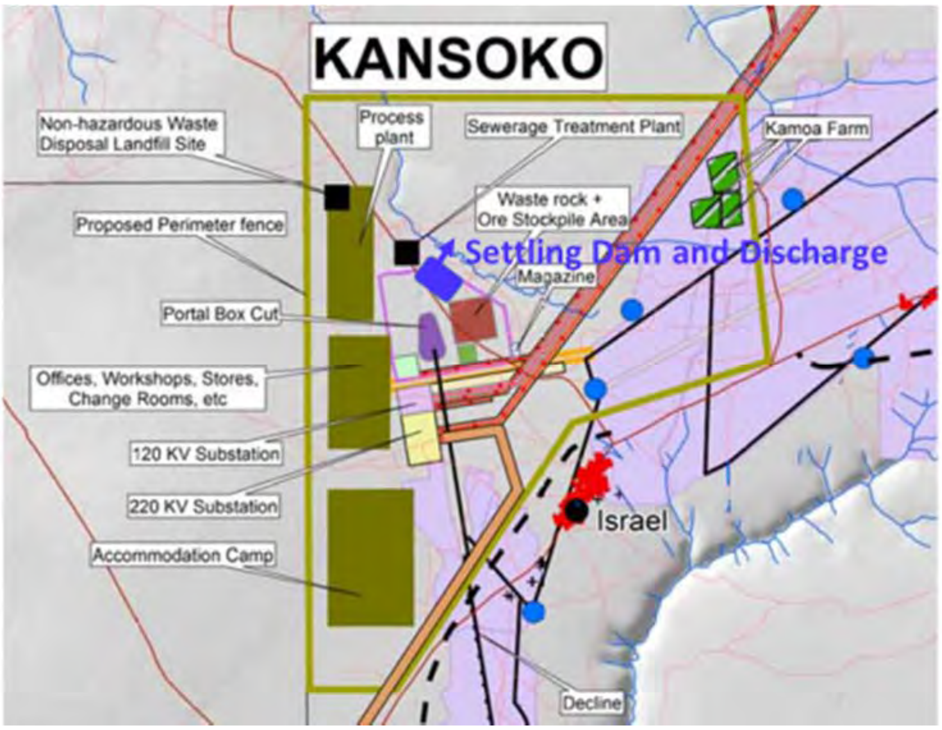


Figure 14: Kansoko discharge point

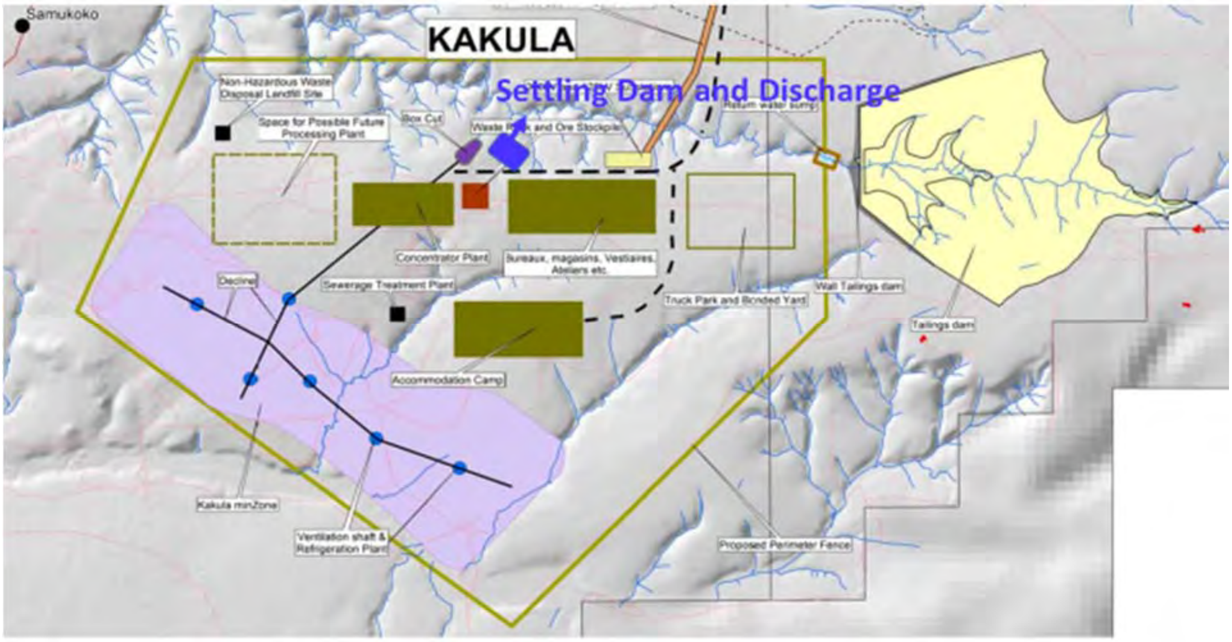


Figure 15: Kakula Discharge Point

3.8 Used Water

A water balance is currently being developed for the Kamoa Copper Project. This water balance is being developed, using the available current information on the underground water management, tailings storage facility (TSF) design and the plant water balances. The current water management system is described below.

Acttivities requiring the use of water

The plants require a certain quantity of raw water for gland water and other uses. This water is required to be of better quality than process water. Where possible, this will be sourced from dewatering at the declines which is expected to supply water at 110 L/s.

Recirculated water supply sources

Process water will be recycled from the thickeners, Tailings Storage Facility (TSF) Return Water Sump and MSW settling ponds, and will be is used at both plants where possible. A very small (1,000 m^3) Return Water Sump is provided at the TSF from where water will be pumped back to the plants. The TSF has been designed as a water storage facility and any excess water will be stored on the TSF rather than in a return water dam.

Uncontaminated runoff water

The plants are designed as zero discharge facilities with water reused in the process. Storm water controls will be developed to separate clean and dirty water and containment facilities (impervious flooring and bunding with return pumps for liquid effluent) established to contain any spills from reagents stores and tanks.

Re-using waste mining water

Mine wasate water pumped to the TSF will be returned to the process.

Possibilities of reducing the volume of water used

Kamoa will monitor water use at Kansoko and Kakula and endeavour to improve efficiency of water use on an ongoing basis.

Possibilities of eliminating the need for water in certain processes

The poissibilty to eliminate water will be evaluated e.g. the possibility of using chemical dust suppressants or tarring roads will be investigated.

Methods proposed or selected to reduce the use of fresh water

The key method selected is the recirculation of mine waste water into the process plant from the TSF.

Methods selected to reduce the influx of uncontaminated runoff water into the mining site water management system

The plants are designed as zero discharge facilities with water reused in the process. Storm water controls will be developed to separate clean and dirty water and containment facilities (impervious flooring and bunding with return pumps for liquid effluent) established to contain any spills from reagents stores and tanks.

Underground Mining Water Balance

The site wide water balance changes as the underground mine develops. The volumes of groundwater ingress into the underground workings increase as the mine expands. This means that the volume of water that will have to be managed by the mine increases which could result in excess mine water on the site.

The key features of the water management of the three stages of the mine development (likely to be similar for both Kansoko and Kakula) are:

- Stage 1 - Temporary Developing Arrangement Figure 16):
  - A temporary pumping arrangement will handle the Mine Services Water (MSW), which is only required by the development fleet and mining operation. MSW will be stored in a surface dam (2,500 m^3 capacity for each mine) and gravity fed underground;

  - Dirty water will be collected at the face and pumped to the nearest permanent dam, which will also control fissure water;
  - The settling system (2 side by side regular HDPE lined earth dams at each mine) will overflow into a transfer dam, which will be pumped back to the MSW dam;
  - Some raw water will be required during this phase, which will be supplied from the MSW tank;
  - Water will be pumped from the MSW tank to the underground workings, which will also receive fissure and backfill water; and
  - Some losses will be incurred from the underground vents, as well as from the settling dam through evaporation.
- Initial Permanent Arrangement (Figure 17):
  - This arrangement will be used while the mines are in full operation until enough space has been mined out to allow for the construction of underground dams;
  - Dirty water will be pumped to the surface settling dams via permanent underground decline cubby dams;
  - The surface dam will overflow into a transfer dam and will pump to the MSW dam. Excess water will be pumped to the plant process storage dam;
  - No raw water should be required at this stage due to sufficient fissure water reporting to the mine workings; and
  - As above, fissure and backfill water will be received into the workings, and some losses will be incurred through vents and evaporation.
- Stage 3 - Permanent Life of Mine Arrangement (Figure 18):
  - This arrangement will be used once there is enough space for underground settling dams. Dirty water will then be transferred to these dams (closer to the mining areas). Settling dams will overflow into clear water dams which will collect fissure water and supply the MSW. Excess water will be pumped to the surface via a clear water pumping system;
  - Similar dirty and settling systems will be used as above; and
  - No raw water make up will be required at this stage due to sufficient fissure water reporting to the mine workings.

Plant Water Balances

The two plants (Kansoko and Kakula) are assumed to operate with the same water requirements throughout the life of mine.

The plants requires a certain quantity of raw water for gland water and other uses. This water is required to be of better quality than process water. Where possible, this will be sourced from dewatering at the declines which is expected to supply water at 110 L/s.

Process water will be recycled from the thickeners, Tailings Storage Facility (TSF) Return Water Sump and MSW settling ponds, and will be is used at both plants where possible. A very small (1,000 m^3) Return Water Sump is provided at the TSF from where water will be pumped back to the plants. The TSF has been designed as a water storage facility and any excess water will be stored on the TSF rather than in a return water dam.

Decline Dewatering and Excess Dirty Water

A system of boreholes is to be installed to dewater the decline shaft at the mine at Kansoko and a similar system will be established at Kakula. The water pumped from the boreholes will be clean water. The water will be used as make up water for the plant and underground workings. The excess water will be discharged to the local water course. The planned dewatering rate is 110 L/s at each mine.

The excess process water for discharge will be produced from the underground workings. This is likely to contain mud, oils and grease and some salts. The proposed settlement/treatment on surface will remove most of the mud and contaminants to make the water usable for underground operations and the plant. The water for discharge is likely to contain elevated salts. Further investigation is ongoing to determine the required treatment methods to enable any discharge to be within DRC effluent discharge limits.

Potable Water

Potable water will be supplied to the each mine site at 36 m^3/d. This water will be used underground as well as in the change houses and offices.

Tailings Storage Facility water balance

The TSF pool has a maximum area of 130 ha (average radius of 650 m). This implies that an average daily rainfall volume of 4,400 m^3 will be received, as well as a daily volume of 7,300 m^3 water with the tailings stream. The losses from the pool are evaporation and entrainment of water in the TSF. The excess water after losses will be returned via the Return Water Sump to both plants for use. The evaporative losses are based on the area of the pool and the annual open body evaporation rates of 1,500 mm per annum. This gives an average daily evaporative loss of 5,600 m^3 per day. The entrainment in the tailings is based on the in-situ void ratio of 1 and the density of the tailings solids of 2.85 tonne/m^3. This gives the entrainment volume as a further 3,000 m^3 per day. The finer tailings material was estimated to have a permeability of about 1×10^{-9} m/s. This permeability was used for the water balance. The seepage rate for the TSF is therefore estimated to be approximately 115 m^3/d for a pool radius of 650 m.

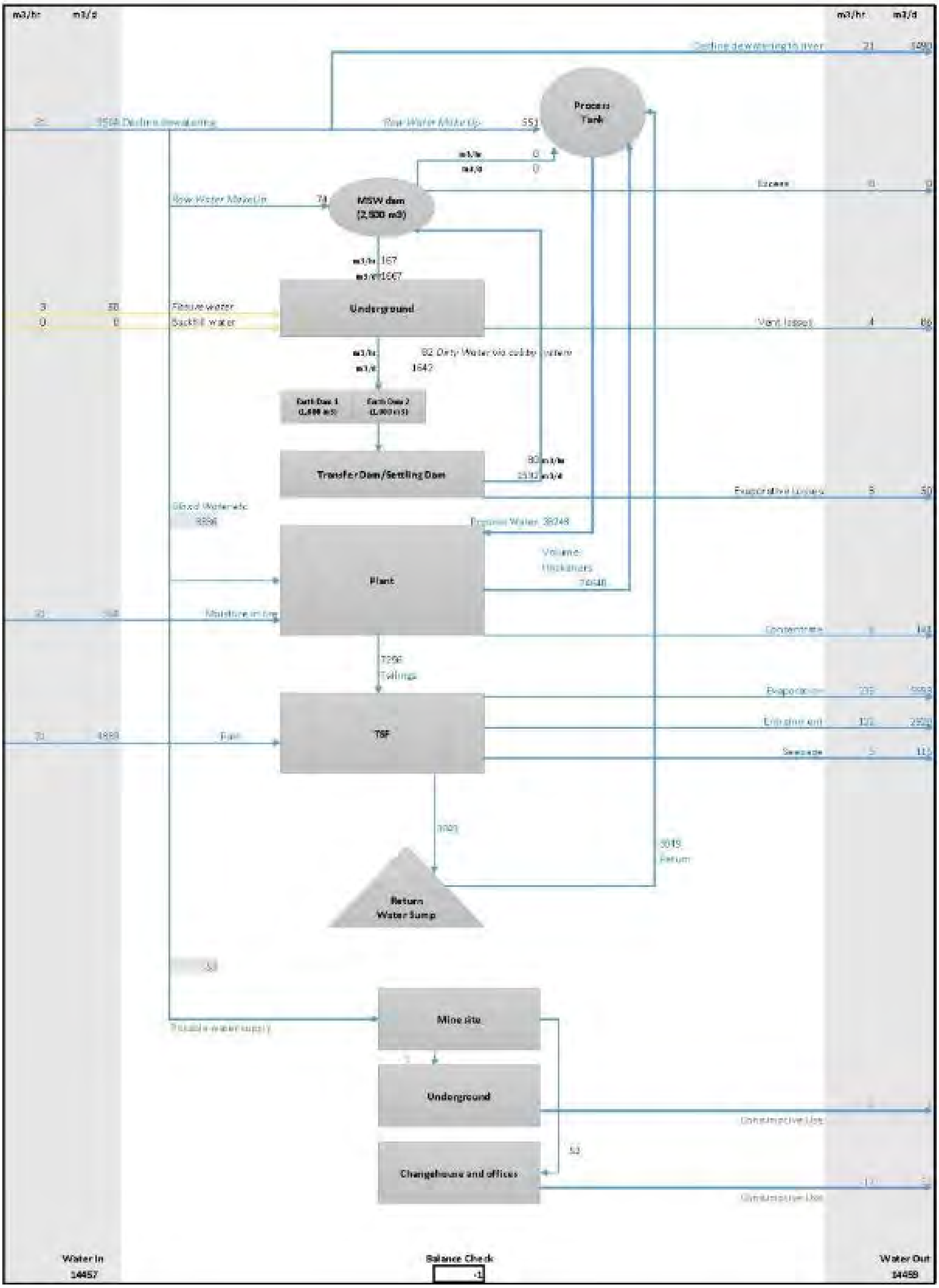


Figure 16: Water Balance: 6 Months (Temporary Development Arrangement) - Kansoko Mine

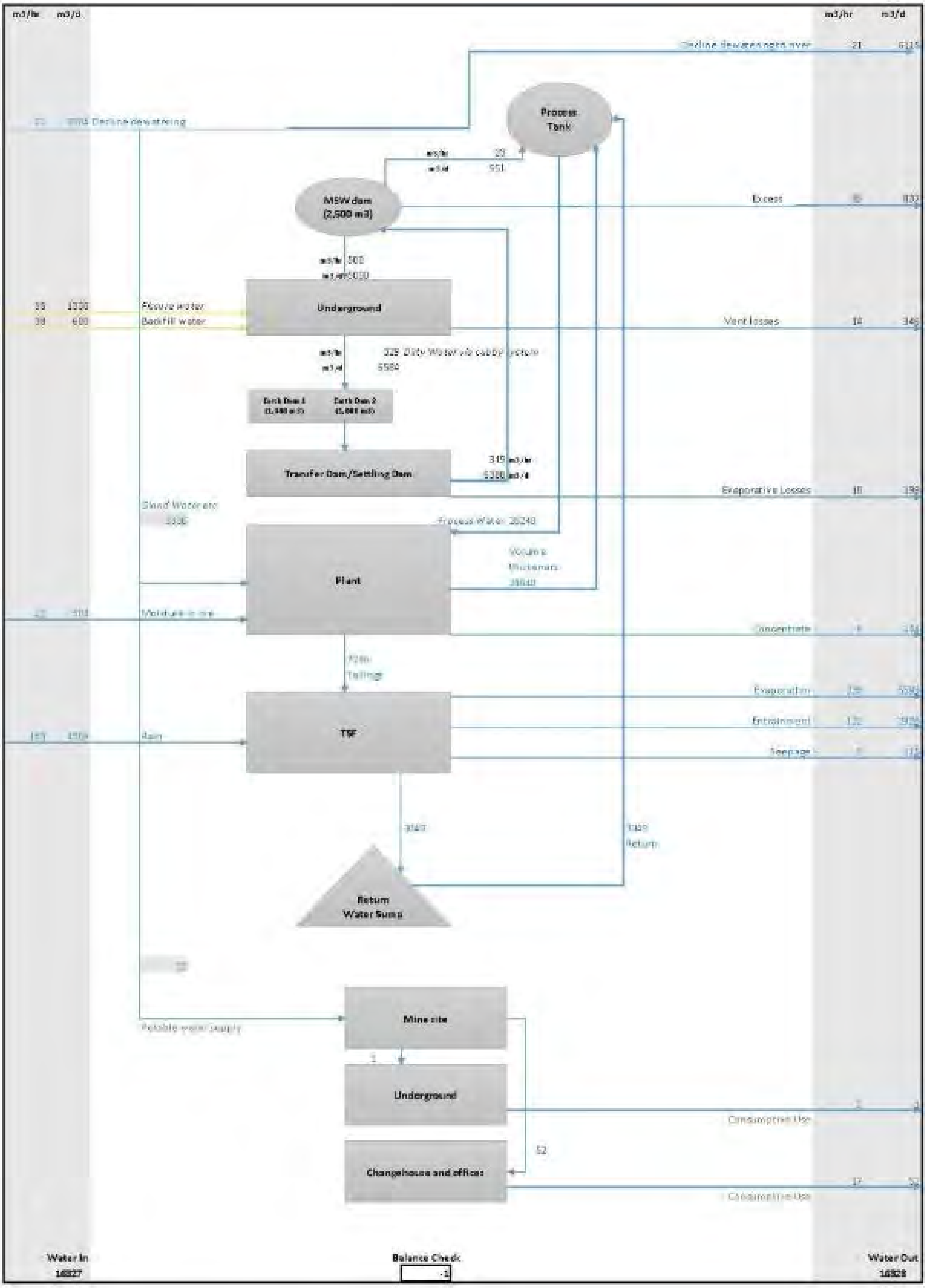


Figure 17: Water Balance: 15 years (Initial Permanent Arrangement) - Kansoko Mine

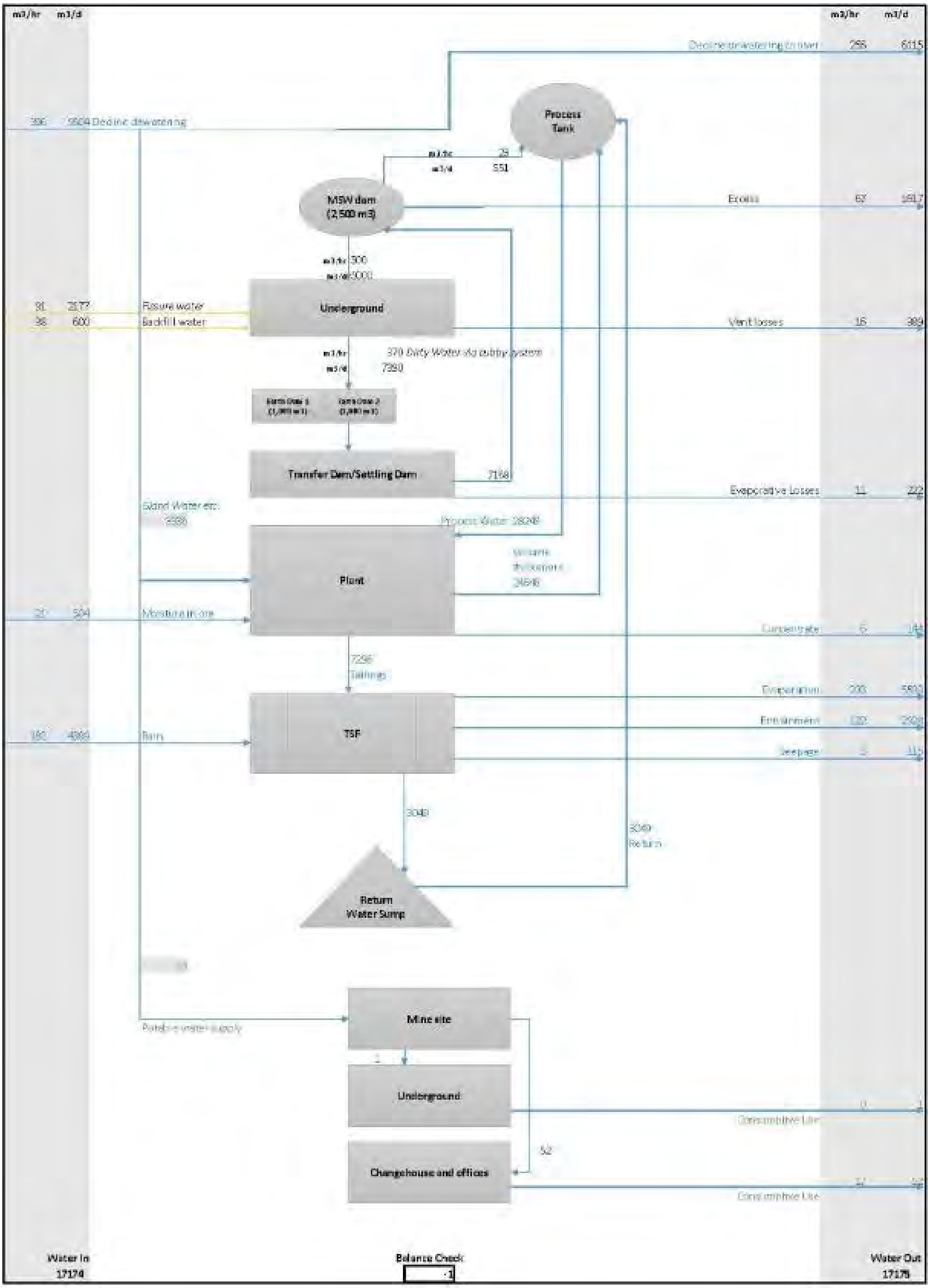


Figure 18: Water Balance: 30 years (Permanent Life of Mine Arrangement) - Kansoko Mine

3.9 Infrastructure and developments

All proposed supporting infrastructure for both mine sites, as listed below, is presented in Figure 4. The following buildings will form part of the Kansoko and Kakula Mines project infrastructure:

- Offices, stores, canteens, change rooms and ablutions;
- Workshops - The engineering workshop facilities will be constructed in proximity to the metallurgical production area. The workshops will incorporate oil-changing facilities, maintenance workshops, and service and machining areas for the construction and operational phases of the Project;
- Storage facilities for reagents etc;
- Diesel storage farms;
- Explosives magazine;
- Emulsion silos;
- Ventilation shafts;
- Purpose-built (11 km wide laterite) access roads from the Kolwezi Airport (Figure 2;
- Borrow pits;
- Agricultural areas;
- Employee accommodation - Housing units will be provided to employees not resident in Kolwezi. Single quarter accommodation is currently planned;
- Services including - canteen, recreation room, swimming pool, sports facilities, fire trailer, gate house and bus loading area, and refuse removal;
- Sewerage facilities at offices and employee accommodation in the form of containerised dedicated treatment facilities;
- Clinic and Medical Facilities - The clinic and first-aid facility will be housed together at a suitable position near the main offices. Medical equipment, including an ambulance, will be provided. Medical evacuation for ex-pat employees will be provided by an outside contracting service;
- The following roads and services will be provided within the Kansoko and Kakula mine licence areas:
  - Perimeter security fences;
  - Internal roads;
  - Parking;
  - Stormwater drainage;
  - Water reticulation, sized for fire flows and provided with hydrants;
  - Sewer reticulation;
  - Sewage treatment;
  - Mast lighting;
  - Transmitters and receivers for mobile telephones; and
  - Internal and external communications.

3.9.1 Electrical Infrastructure – Power

The project will need 20 Mega Watts (MW) of combined power for construction of the Kansoko and Kakula operations and a combined power requirement of approximately 200 MW for the operating phases.

Ivanhoe Mines has signed a memorandum of understanding and a first pre-financing agreement with Societé Nationale d'Electricite (SNEL) to upgrade the Mwadingusha and Koni Hydroelectric Power Plants near Likasi as well as for the Nzilo hydropower plant near Kolwezi.

Two new 220/120 kV substations will be constructed adjacent to the processing plant at Kansoko and Kakula and required power will be delivered to the site by a new 30 km 220 kV transmission line and a new 10 km 220 kV transmission line. All power infrastructure is to be owned and operated by Kamoa Copper SA.

3.9.2 Agricultural Areas

Kamoa Copper SA is mandated by the Government of Lualaba Province to establish 500 ha of maize production in the concession area. Kamoa Copper SA has commenced the Smallholder Maize Production Programme (SMPP) with up to 150 to 200 ha's in 2016. Kamoa Copper SA has also commenced programs to develop sustainable livelihoods projects in the Project area. Part of the Project's objectives is to address food security in the area through an extension programme introducing Conservation Agriculture (CA) techniques, systems and cultivars. Demonstration plots have been established and lead farmers trained with the creation of CA plots in the community. This has been rolled out throughout the community.

Other aspects of this project are the production of vegetables, honey, aquaculture and improved food processing and in future the introduction of draft power, poultry production, micro-businesses with a gender focus and the storage of seed.

3.9.3 Resettlement Areas

All effort is currently being made to avoid involuntary resettlement. For Kansoko mine an area of 7 km^2 is planned to be fenced off for most of the planned surface infrastructure. This area was surveyed in 2016 and compensation made to individuals and communities for loss of crops, fields and access to this land. No physical resettlement is required for the Kansoko mine and no grave sites were identified inside the planned perimeter fence.

For Kakula mine, an area of 21 km^2 is planned to be fenced off for most of the planned surface infrastructure. 45 Households were surveyed in this area in 2016 and a complete survey was made of all structures belonging to these 45 households. The resettlement compensation and process still needs to be determined in consultation with the affected people. In 2017 it is planned to complete a detailed survey of all fields inside the planned fence and to complete the compensation before construction of the fence. No grave sites were identified inside the planned perimeter fence for the Kakula mine, however one graveyard has been identified within the Kakula area directly above undergsound mining area, which may be affected by underground mining should subsidence occur.

All resettlement will be done according to DRC legislation as a minimum and in consultation with affected communities, leaders and authorities.

In order to adequately and satisfactorily mitigate and offset impacts of physical and economic displacement associated with the Project, Kamoa Copper SA is committed to carrying out any involuntary resettlement in line with DRC regulations.

Alternatives areas for resettlement will be discussed and agreed with those affected by the Project prior to any displacement. A Resettlement Action Plan (RAP) will be conducted in accordance DRC regulations. This will include a resettlement survey for households, structures, assets, fields and so forth for replacement, and/or, compensation.

3.10 Ores and Concentrates

3.10.1 Ore Mineralogy

Between 2010 and 2015 a series of metallurgical testwork programs were completed on drill core samples of known Kamoa deposit mineralisation (containing the Kansoko and Kakula Deposits), as illustrated in Figure 19. These investigations focussed on the metallurgical characterisation and flowsheet development for the processing of copper mineralisation. The metallurgical drilling coverage provides a broad spectrum of samples from across the Project resources. The Phase 6 samples best represent ores to be processed in the early years (years 1 to 15) at the Kansoko Mine. Testwork for the Kakula Mine is in progress.

The deposits are almost entirely sulphide ore consisting of chalcocite (Cu_2S), bornite (Cu_5FeS_4), chalcopyrite ($CuFeS_2$) and pyrite (FeS_2). The waste rock layer above the ore is a pyritic siltstone, rich in pyrite (FeS_2). Preliminary tests indicate that all of these will be acid-generating (particularly the pyritic siltstone) with high concentrations of sulphate, aluminium (Al), copper (Cu), chromium (Cr), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se) and zinc (Zn).

In contrast, the footwall Roan Sandstone and the overburden Upper Diamictite are expected to yield a neutral drainage quality with low concentrations of metals.

Copper grades of the Kansoko ore as indicated in the Phase 6 metallurgical composite samples are presented in Table 17. Composites representing years 0 to 4 were tested under the label Phase 6A and composites representing years 5 to 15 were labelled Phase 6B. Figure 21 summarises the bulk modal mineralogy for the composites from testwork phases 2 to 4. Figure 22 summaries the copper mineralogy of the feed composites (AMC Consultants, 2013).

Table 15: Phase 2, Phase 3 and Phase 4 Metallurgical Composite Samples

Sample Name	Areas Targeted	Mineralisation	Cu Grade (%)	Date
Phase 2 Hypogene	Kansoko Centrale, Kansoko Nord	Hypogene	3.29	Apr 2011
Phase 3 Hypogene	Kansoko Centrale (Deep), Kansoko Sud (Deep), Kamoa Ouest	Hypogene	3.89	Aug 2012
Phase 2 Supergene	Kamoa Ouest (Deep)	Supergene	3.73	Dec 2011
Phase 3 Supergene	Kamoa Ouest, Kansoko Centrale, Kansoko Nord	Supergene	4.19	Aug 2012
Phase 4	Kamoa Ouest	Mixed	Variable (+/- 2.3%)	Feb 2013

Table 16: Phase 6 Kansoko Mine Metallurgical Composite Samples

Phase	Area Targeted	Sample	Cu Grade (%)	Date
6A	Kansoko Sud	6A1 DC	3.67	Mar 2016
	Kansoko Sud	Hypogene	3.57	Mar 2016
	Kansoko Sud	Supergene	3.68	Mar 2016
6B	Kansoko Sud	6B1 DC	3.27	Mar 2016
	Kansoko Sud	Hypogene	2.99	Mar 2016
		Supergene	3.87	Mar 2016

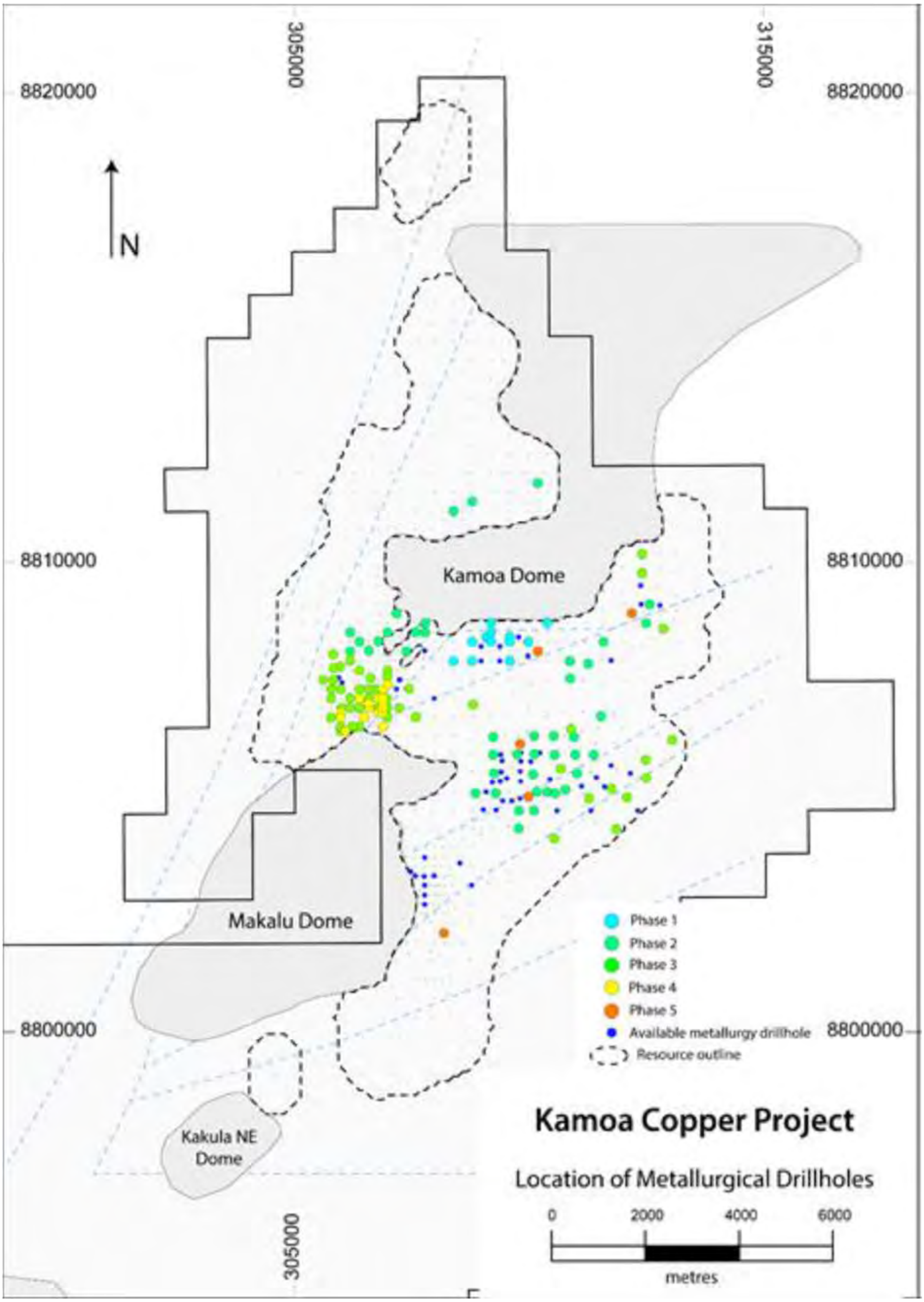


Figure 19: Metallurgical Sampling Map - Phase 6 (OreWin, 2016)

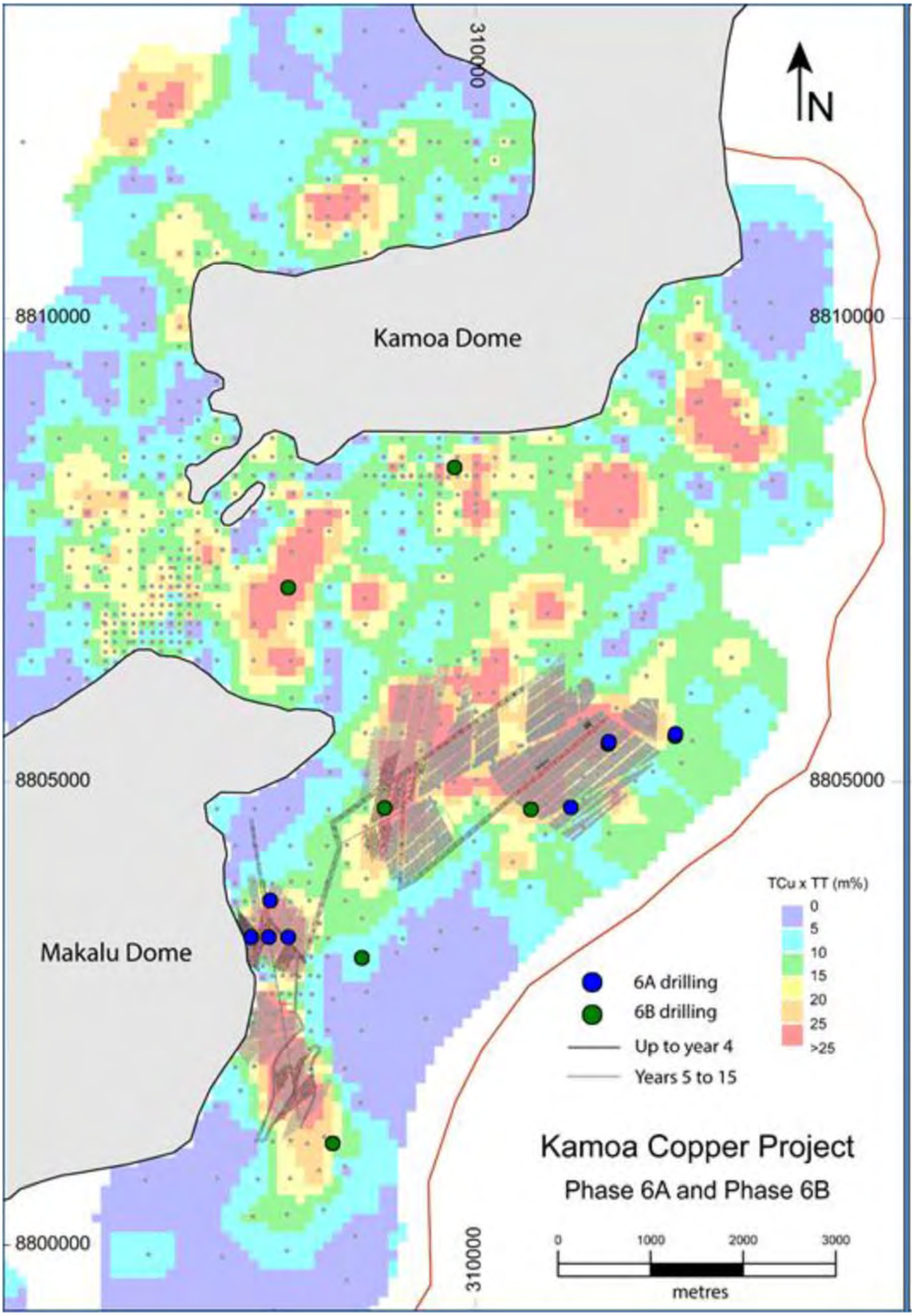


Figure 20: Metallurgical Sampling Map - Phase 6 (OreWin, 2016)

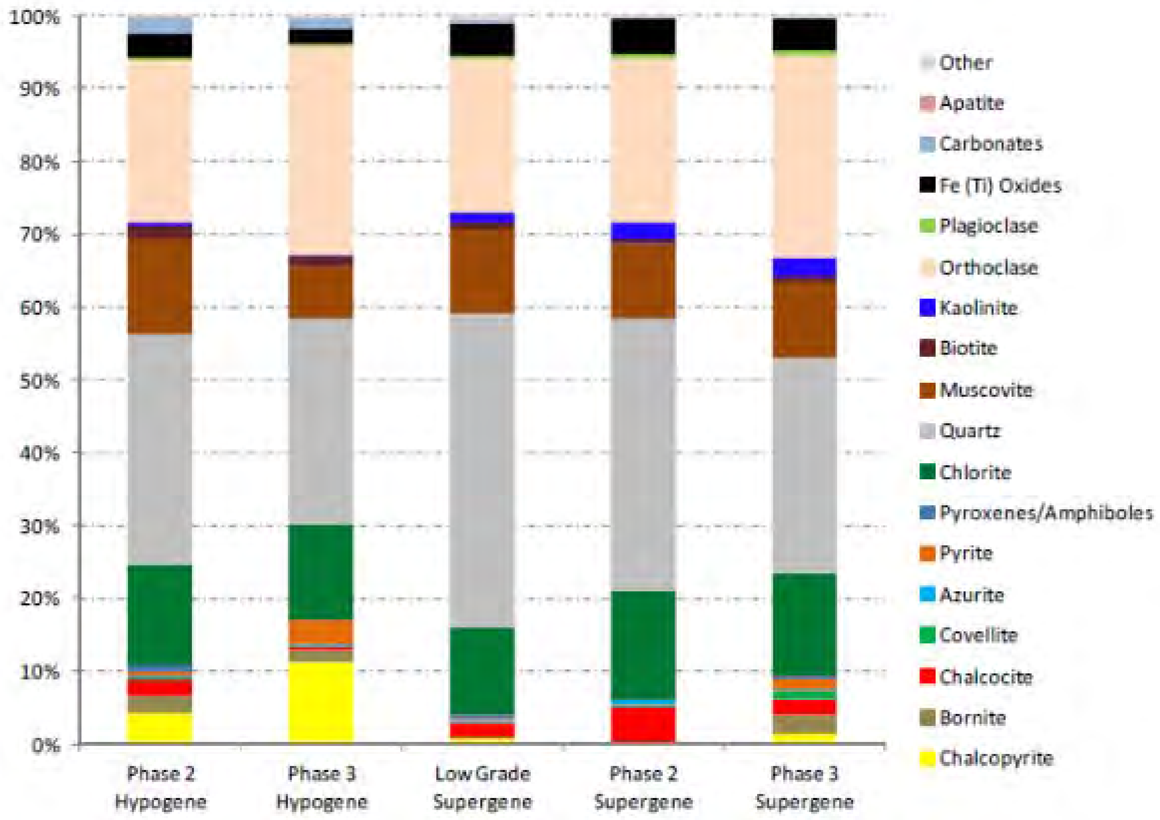


Figure 21: Modal Mineralogy of Phase 6 Feed Composites (XPS, 2013)

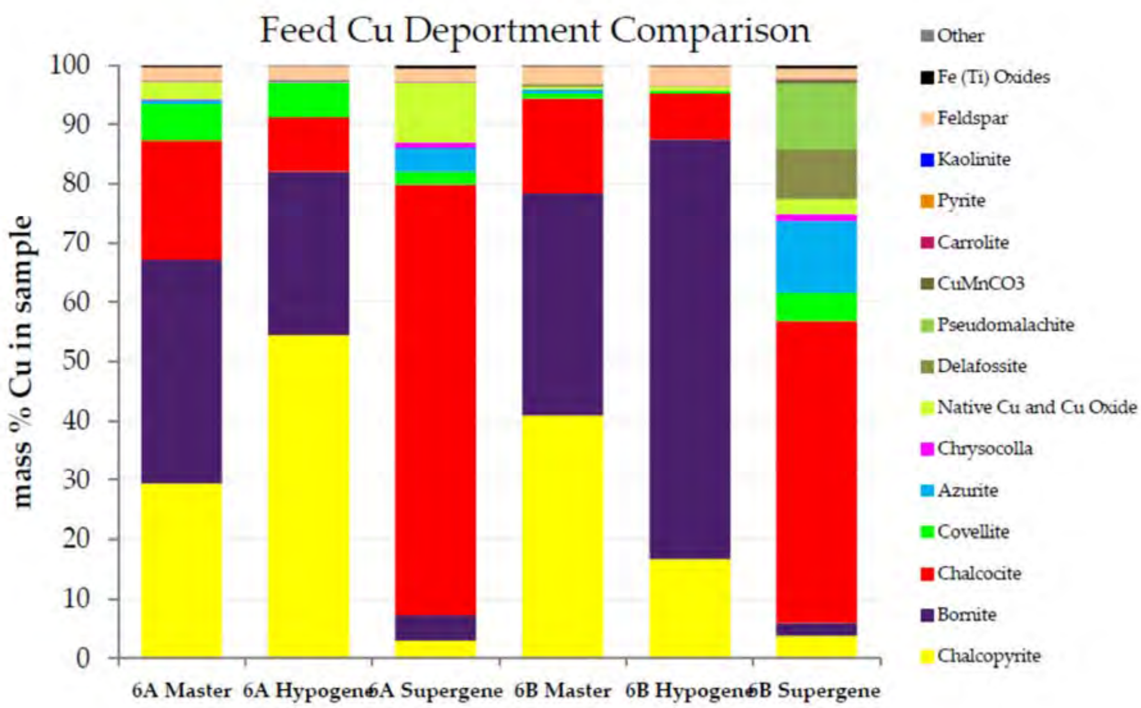


Figure 22: Copper Mineralogy of Feed Composites

3.10.2 Concentrate Mineralogy

Testwork to date has shown that there are no penalty elements present that reach problematic levels in the concentrates produced. The main impurity element is silica, and testwork is being undertaken to minimise silica recovery. Saleable concentrates are summarised in Table 17 below.

Table 17: Trace Element Analysis of Concentrates

Parameter	Phase 2 Hypogene	Phase 3 Hypogene	Phase 2 Supergene	Phase 3 Supergene
Mass Pull	7.7	13	6.0	9.5
Cu	37.01	27.29	51.52	35.82
Se	24.62	29.32	13.12	20.12
Fe	18.32	24.96	5.22	12.78
SiO_2	13.11	10.68	18.09	19.38
CaO	0.14	0.11	0.26	0.07
MgO	0.75	0.64	0.85	0.76
Al_2O_3	3.33	2.71	4.00	4.97
As (%)	0.005	0.013	0.01	0.013
Bi (%)	0.009	0.008	0.006	0.01
Cd (%)	0.0002	0.0002	0.005	0.0002
Cl (%)	0.0016	0.02	0.01	0.054
Co (%)	0.053	0.072	0.008	0.12
Hg (ppm)	0.49	0.77	0.638	0.89
Pb (%)	0.022	0.026	0.008	0.12
Sb (%)	0.01	0.0001	0.005	0.001
Se (%)	0.01	0.001	0.005	0.002
Te (%)	0.01	0.001	0.005	0.001
Zn (%)	0.055	0.109	0.020	0.016
F (%)	0.029	0.035	0.010	0.058

3.10.2.1 Ore Stockpiles

Mineralised material from both the Kansoko and Kakula underground developments will be conveyed to the surface via an incline conveyor at each portal. A slewing stacker will provide the facility to discharge ROM material onto a pad (emergency stockpile) or directly onto a conveyor system for transfer of the material to the concentrator plant ROM stockpiles.

The emergency stockpiles at each portal are required to allow for continuous mining operations in the event of non-availability of downstream equipment up to the ROM stockpiles. A maximum emergency ROM stockpile capacity of 16 hours is envisaged at each portal. Material from these emergency ROM stockpiles can be reclaimed and reintroduced onto the overland conveyors by means of front-end loaders. If additional storage is required, material can be hauled from the emergency stockpiles to the start-up/ramp up stockpile area at each portal. Start-up stockpiles of around 1.0 Mt are required near the Kansoko and Kakula portals, to provide for early mining production that commence 12 to 18 months before the concentrators are commissioned. Approximately 2.0 Mt of combined ROM material is to be stored at the Kansoko and Kakula Mine portals as a ramp-up stockpile. Feed systems are allowed for on the overland ROM conveyors to load these stockpile materials when they are required.

A ROM conveying system is to be installed from the Kansoko decline portal, up to the Kansoko ROM stockpile for the 4 Mtpa concentrator.

In addition, a ROM conveying system is to be installed from the Kakula decline portal, up to the Kakula ROM stockpile for the 4 Mtpa concentrator at this site. These conveyor systems are sized to handle the full production from the Kansoko and Kakula operations respectively.

3.11 Mine Waste

Article 58 (Annexure IX of Decree No 038/2003), requires that mine waste (tailings, waste rock and slag, etc.) is characterised as either low or high risk waste, with specific mitigation measures required for high risk waste prescribed.

The characterisation of mining waste is determined as indicated in Annexure XI of Decree No 038/2003. Low risk waste is waste with leachate quality less than the guideline values for low risk waste, whereas waste is considered high risk as follows:

- Leachate quality exceeds the contaminant thresholds outlined in Table 18;
- Is determined to be radioactive; or
- Contains more than 5mg/kg of polychlorinated Biphenols (PCBs).

Waste is considered acid generating if:

- It contains >0.3% sulphides;
- Its acid generation potential has been determined through kinetic testing;
- Its potential net acid neutralisation potential is less than 20 kg $CaCO_3$/tonne; and/or
- Its potential acid neutralising the acid generation is less than 3.

The leachability of mineral waste must be determined utilising Toxicity Characteristic Leaching Procedure EPA-1311 to determine the level of risk.

Specific mitigation measures must be followed for mineral waste as indicated in the flow diagram illustrated in Article 58 (Annexure IX of Decree No 038/2003).

Table 18: Determination of Low Risk and High Risk Waste (Annexure XI of Decree No 038/2003)

Low Risk Mine Waste		High Risk Waste	
Parameter	**Criteria mg/l**	**Parameter**	**Criteria mg/l**
Arsenic	< 1.00	Arsenic	> 5.00
Cadmium	< 0.10	Barium	> 100.00
Chrome (Hexavalent)	< 0.05	Boron	> 500.00
Copper	< 0.30	Cadmium	> 0.5
Nickel	< 0.50	Chrome (Total)	> 5.0
Free Cyanide	< 0.10	Total Fluoride	> 150.00
Mercury	< 0.002	Free Cyanide	> 0.1
Lead	< 0.6	Mercury	> 0.01
Chrome (total)	< 1.0	Nitrate and Nitrites	> 1000.00
Iron (total)	< 2.0	Nitrites	> 100.00
Zinc	< 1.0	Lead	> 5.0
Cyanide (total)	< 1.0	Selenium	> 1.0
		Uranium	> 2.0
		Cyanide (total)	> 1.0

A specialist geochemical study to quantify the Acid Rock Drainage (ARD) and Metal Leaching (ML) risks associated with the Kamoa Copper Project mining activities as well as to inform the designs of the waste rock and ore stockpiling facilities, material handling strategies and mine water management strategies is in progress for the Project. This geochemical assessment is being conducted in two phases, including a scoping study (predominantly based on available data and geochemical characterisation program results) and a prefeasibility study that includes an impact statement. The scoping study has been completed with detailed feasibility studies ongoing.

Previous geochemical characterisation has been conducted by Golder (2010) to identify the lithological units with highest ARD risk. The data from this study was included as part of this geochemical scoping study characterisation. The geochemical characterisation involved sampling, conducting standard static and kinetic geochemical testwork and interpretation of results. The waste rock and ore samples were collected by a Golder consultant in July 2012. The samples (86 in total) were received by Golder (South Africa) in August 2012. Kamoa Phase 2 tailings sample was received from Patterson and Cook in December 2012 and XPS (Canada). The samples submitted to accredited laboratories (SGS – Johannesburg and/or Canada respectively) for geochemical analyses. The analytical results were then interpreted in the context of available information, and the DRC Mining Code.

The key findings from the Kamoa geochemical characterisation study are:

Physical and chemical characteristics for each type of mine waste

Waste Rock Materials Waste Classification

For the waste rock risk classification sulphide sulphur content and Sulphide Neutralising Potential Ratio (SNPR) results were used.Figure 23 illustrates the scatter plot of SNPR versus sulphide content for waste rock samples from Kamoa and is based on DRC Mining Code Annexure XI of Decree No 038/2003 guidelines.

The following inferences are made from Figure 23:

- Ki 1.1.3: Upper diamictite is Potentially Acid Generating (PAG) (5 samples);
- Ki 1.1.2: Kamoa pyritic sandstone waste rock is mostly PAG (87%);
- Ki 1.1.1.3: Clast-poor diamictite is generally PAG (53%);
- Ki 1.1.1.2: Intermediate Siltstone is PAG (1 sample);
- Ki 1.1.1.1: Clast-rich diamictite waste rock is not PAG; and
- R 4.2: Roan Sandstone is generally not acid generating (64%).

According to criteria the Pyritic Siltstone (Ki 1.1.2), selected Clast-poor (Ki1.1.1.3) diamictite, Upper Diamictite (Ki 1.1.3), Intermediate Siltstone (Ki 1.1.1.2) and selected Roan Sandstone (R 4.2) waste rock samples classify as PAG. The Roan Sandstone samples that are PAG were sampled close to the mineralised zone (contact zone with Roan Standstone) and contains sulphide >0.3%.

Kinetic testing confirmed that KPS and Upper Diamictite are PAG and that waste rock from the mineralised zone (Ki 1.1.1) is not acid generating. Based on acid generation potential specified in the DRC Mining Code the KPS and upper diamictite is a high risk waste material that may require an engineered barrier to limit impacts on the receiving environment in the vicinity to of the proposed Waste Rock Dump.

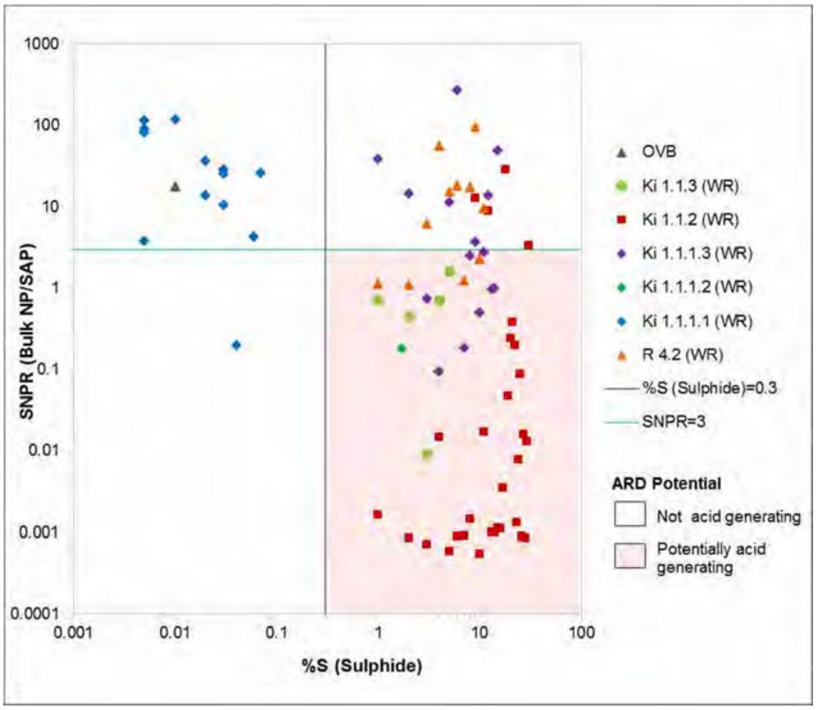


Figure 23: Net potential ratio (SNPR) versus sulphide sulphur for Kamoa waste rock samples (Golder, 2012)

Summary

An evaluation of the acid generation potential and neutralisation potential using the DRC Mining Code Waste Classification (2003) criteria classified the waste rock samples as:

- The Overburden sample has no potential of generating acid;
- Upper Diamictite (Ki 1.1.3) is potentially acid generating (PAG) (5 samples);
- PS (Ki 1.1.2) waste rock is mostly PAG (87%) and the remaining 13% is Non Potentially Acid Generating (Non-PAG) since the sulphide sulphur <0.3% and these samples originate from the leached zone;
- Clast-poor Diamictite (Ki 1.1.1.3) is generally PAG (53%);
- Intermediate Siltstone (Ki 1.1.1.2) is PAG (1 sample);
- Clast-rich Diamictite (Ki 1.1.1.1) waste rock is non- PAG; and
- Roan Sandstone (R 4.2): generally Non-PAG (64%) with exception to the few Roan waste rock located on the contact with mineralised zone.

Based on acid generation potential specified in the DRC Mining Code the KPS and upper Diamictite are high risk waste material that may require an engineered barrier to limit impacts on the receiving environment in the vicinity to of the proposed Waste Rock Dump. All other waste sources are classified as low risk and therefore do not need any containment measures and will likely be utilised for road aggregate or tailings wall construction.

Kamoa anticipate that there will be approximately 60,000 tonnes of KPS and upper Diamictite waste generated from the Kansoko mine and likely a similar amount from Kakula. The following temporary containament measures will be applied for these materials:

- A compacted laterite pad with berms will be constructed on top of the existing waste rock dump at Kansoko and the proposed waste rock dump at Kakula to contain the acid rock and minimise potential acid seepage;
- Once dumping of the KPS and upper Diamictite waste has been completed Kamoa will cap it with compacted top soil to reduce oxidation and water ingress; and
- Groundwater around the WRD will be monitored and runoff from the WRD will be collected and monitored.

It should be noted that no irreplaceable aquifers have been identified in the Kansoko or Kakula areas. A permanent storage solution will be developed in line with the DRC mining code (i.e. a lined storage facility inclusive of leak detection and groundwater monitoring upstream and downstream of the facility as per the Level B permeability measures).

Tailings

The Kamoa tailings was found to be not acid generating according to DRC Mining Code To asses metal leaching synthetic acid rain and deionised SLP was conducted. The metal leaching resulst and exceedances are indicated in Table 19. For the classification of the tailings, the Toxicity Characteristic Leaching Procedure (TCLP), EPA method 1311 was used to determine leachable concentrations of COI in the tailings samples.

According to Article 3 of Annexure XI, mine waste is considered leachable mining waste if, when tested according to the TCLP test, the waste “produces a leachate containing a contaminant concentration greater than the criteria applicable to the protection of groundwater but does not produce a leachate containing a contaminant in a concentration exceeding the criteria indicated” for high risk mining waste.

The analytical results of the tailings TCLP extracts compared to the DRC Mining Code (Annexure XI) guideline are presented in Table 24. The results for the “TCLP Blank” are included in the table to show the concentrations of COI in the extractant.

1) These TCLP results indicate the following for the Kamoa Phase 2 tailings materials tested.
2) The Cu, Fe and Fe (total) concentrations in both the Hypergene and Supergene samples exceeded the Low Risk criteria but were still below the High Risk criteria.
3) The Cr(VI) in the Supergene sample are equal to the Low Risk criteria.
4) The concentrations of all other potential CoCs were below the Low Risk Mine Waste guideline concentrations.

Table 19: Summary of TCLP inorganic results for Kamoa Phase 2 tailings samples compared to DRC Mining Code (2003) values for low and high risk waste

Parameter	Units	Low risk Mine	High risk	Hypogene	Supergen	TCLP
EC	mS/m	ng	ng	58	229	53
Final pH (TCLP)	-	ng	ng	3.5	4.2	2.9
Al	mg/l	ng	ng	11	9	<0.02
NH_3 as N	mg/l	ng	ng	0.34	0.41	0.09
Ag	mg/l	ng	ng	<0.002	0.006	<0.002
As	mg/l	<1	>5	<0.01	<0.01	<0.01
Ba	mg/l	ng	>100	0.42	1.1	0.035
Be	mg/l	ng	ng	0.0025	0.0039	<0.0001
Bi	mg/l	ng	ng	<0.03	0.09	<0.03
B	mg/l	ng	>500	0.04	0.06	0.015

Parameter	Units	Low risk Mine	High risk	Hypogene	Supergen	TCLP
Cd	mg/l	<0.1	>0.5	0.002	0.006	<0.001
Ca	mg/l	ng	ng	4.8	192	<0.5
Cl	mg/l	ng	ng	0.2	0.21	0.14
Cr Total*	mg/l	<1	>5	0.064	0.06	<0.002
Cr (VI)	mg/l	<0.05	ng	0.04	**0.05**	<0.01
Co	mg/l	ng	ng	0.027	0.071	<0.005
Cu	mg/l	<0.3	ng	**89**	**29**	<0.02
CN (Total)	mg/l	<1	>1	<0.005	<0.005	<0.005
CN(Free)	ppm	<0.1	>0.1	<0.01	<0.01	<0.01
F	mg/l	ng	>150	0.11	0.14	<0.05
Fe	mg/l	<2	ng	**17**	**61**	<0.05

Based on the TCLP results (Table 19) the Kamoa Phase 2 tailings classify as "Leachable Waste" due to the elevated concentrations of Cu and Fe in the TCLP extraction, exceeding the Low Risk criteria.

The PCB results indicated that all PCBs were below detection limits in both the tailings samples (Table 20) therefore classify as Low Risk based on PCB concentrations.

Table 20: PCB concentrations in Kamoa Phase 2 Tailings samples

PCBs	Units	Hypogene	Supergene	TCLP Blank
PCB 28	µg/kg	<0.1	<0.1	<0.1
PCB 44	µg/kg	<0.1	<0.1	<0.1
PCB 49	µg/kg	<0.1	<0.1	<0.1
PCB 52	µg/kg	<0.1	<0.1	<0.1
PCB 60	µg/kg	<0.1	<0.1	<0.1
PCB 66	µg/kg	<0.1	<0.1	<0.1
PCB 70	µg/kg	<0.1	<0.1	<0.1
PCB 74	µg/kg	<0.1	<0.1	<0.1
PCB 77	µg/kg	<0.1	<0.1	<0.1
PCB 82	µg/kg	<0.1	<0.1	<0.1
PCB 87	µg/kg	<0.1	<0.1	<0.1
PCB 99	µg/kg	<0.1	<0.1	<0.1
PCB 101	µg/l	<0.1	<0.1	<0.1
PCB 105	µg/l	<0.1	<0.1	<0.1
PCB 114	µg/kg	<0.1	<0.1	<0.1
PCB 118	µg/kg	<0.1	<0.1	<0.1
PCB 126	µg/kg	<0.1	<0.1	<0.1
PCB 128	µg/kg	<0.1	<0.1	<0.1
PCB 138+158	µg/kg	<0.1	<0.1	<0.1
PCB 153	µg/kg	<0.1	<0.1	<0.1
PCB 156	µg/kg	<0.1	<0.1	<0.1

PCBs	Units	Hypogene	Supergene	TCLP Blank
PCB 166	µg/kg	<0.1	<0.1	<0.1
PCB 169	µg/kg	<0.1	<0.1	<0.1
PCB 170	µg/kg	<0.1	<0.1	<0.1
PCB 179	µg/kg	<0.1	<0.1	<0.1
PCB 180	µg/kg	<0.1	<0.1	<0.1
PCB 183	µg/kg	<0.1	<0.1	<0.1
Total PCB	***µg/kg***	***<0.1***	***<0.1***	***<0.1***

As the tailings is leachable waste, Level A containment measures will be applied to tailings storage. Geotechnical and hydrogeological evaluations of the proposed TSF site are currently being undertaken to determine the permeability of the soils and if there is a hydraulic connection with an underground aquifer. These studies will confirm if any improvements to containment will be required (e.g. soil compaction during site clearance or a form of engineered barrier and/or a liner).

3.12 Mine waste storage facility areas

3.12.1 Location of waste storage facilities

The location of the water storage facilities are presented in Figure 24. These storage areas comprise of a small waste rock dumpto contain 60 000 tonnes of KPS waste rock (which has been identified as potentially acid generating) from the Kansoko decline and a single tailings facility which will recived tailings from both the Kakula and Kansoko plants. All other waste rock will be used for road construction, terraces and other infrastructure.

3.12.2 Waste Rock Dumps

The proposed KPS WRD site is situated east of, and immediately adjacent to, Decline 1 at Kasnoko and is bounded on its eastern perimeter by an access road. The site has a gentle slope towards the north.

Figure 24: KPS WRD Site locations

The total surface area will be 7 200 m^2, and its capacity will be 30 000 m^3 or 60 000 tons. The type of waste will be KPS waste rock. A Composite: Laterite base, HDPE Geomembrane, Drainage/protection layer will be installed to protect groundwater from any potential acid drinagae.

The WRD will be developed utilising the following design and maintenance principles:

- Appropriate terrace and lift height specifications based on the nature of the material and local geotechnical considerations to minimize erosion and reduce safety risks;
- Ensuring that potential changes of geotechnical properties in dumps due to chemical or biologically catalysed weathering are monitored;
- Placing a proper cover system, which would prevent precipitation from percolating into the dump's body for closed waste rock dumps which are not required for future mine development;
- Appropriate factors of safety;
- Wind erosion reduction measures (e.g. through concurrent rehabilitation of closed areas and establishing perimeter vegetative screens);
- Waste rock dumps will be rehabilitated so that they are aesthetically pleasing and blend in with the surrounding environment as far as possible. The following measures will be implemented at closure:
  - Place topsoil over the waste rock dumps to limit infiltration into the WRD and possible seepage of contaminated water into the groundwater system;
  - Infill areas of erosion along the side slopes of the waste rock dump and vegetate;
  - Construct toe paddocks along the toe of the facility, where the accumulation of sediment as a result of erosion is likely to impact on the surrounding environment;
  - Conduct cursory improvement of upper surfaces to limit excessive ponding; and
  - Allow natural vegetation to establish and maintain as far as possible.

Geotechnical testwork is currently ongoing and will further inform final design.

3.12.3 Tailings Storage Facility

The Project design assumes 200Mt of mineralised material will be treated over the life-of-mine, with over 92% being discharged as tailings. Two potential tailings storage facility sites east and northeast of the Kakula Mine site have been identified and are being evaluated (EPOCH, 2016).

Currently the Kakula East TSF candidate site (Figure 4 and Figure 25) is the preferred TSF due to the following fundamental reasons:

- Site is located within the upper part of a catchment area;
- There are only small water flows within the Kakula river catchment area where the proposed Kakula TSF will be located; and
- This option lends itself to a phased development for the first four years of tailings deposit (Phase 1) and Phase 2 (ultimate phase) to accommodate the Life-of-Mine (LOM) tonnages.

Various tailings disposal methods were compared, namely filter cake, paste or thickened tailings and tailings slurry. Using a scoring system, it was concluded that disposal using the slurry method is the preferred option for this site.

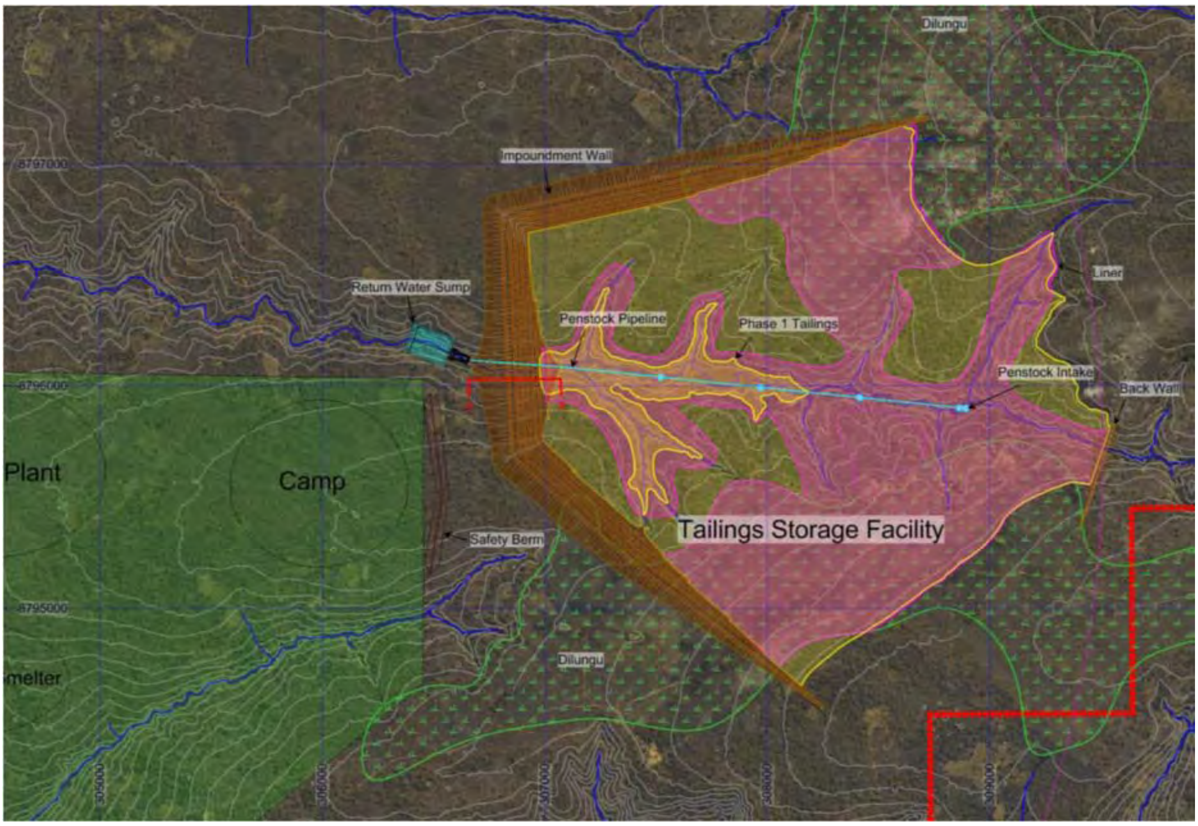


Figure 25: Proposed Kakula TSF

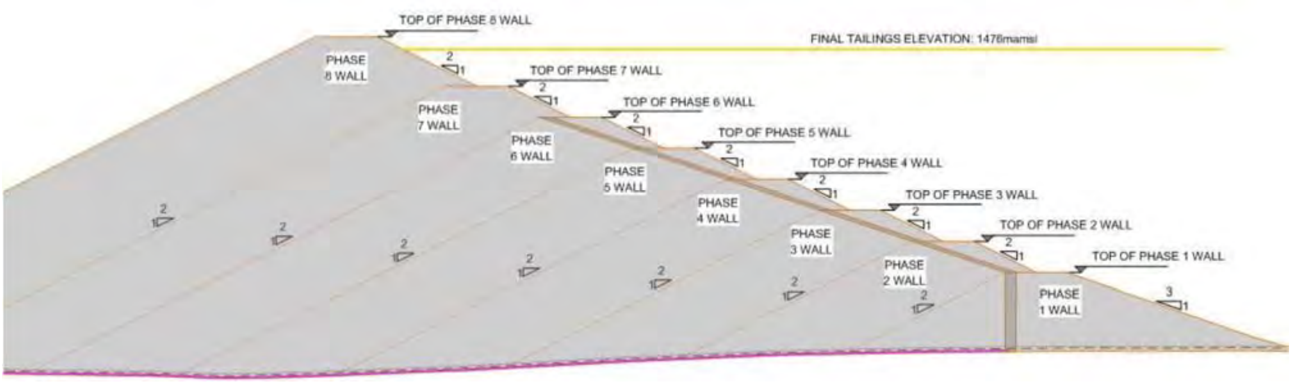


Figure 26: Proposed TSF wall configuration

The Kakula East TSF has been designed to comprise the following aspects:

- The TSF will be expandable to receive tailings beyond the initial 25 year planned mine life;
- Due to fine nature of tailings, dam walls need to be constructed as ‘full containment’ walls constructed in the ‘downstream’ method. This is the safest type of wall construction;
- Walls will be lifted progressively as the dam fills, always providing >1 m freeboard for safety and constructability reasons;
- Construction of the dam walls will therefore continue throughout the life of the mine. After 25 years, the maximum height of the wall will be 51 m;

- There is a possibility of changing to 'upstream' construction for the last few lifts to reduce the amount of construction material required for the wall. This will be evaluated in detail closer to the time;
- Wall construction material will be taken from the basin of the TSF, waste rock from the mine developments and from nearby the outsides of the walls;
- The basin of the TSF will be lined with plastic or bentonite mix if necessary to comply with DRC legislation (i.e. if the tailings are at all hazardous and if the ground is permeable);
- Excess water can be stored on the TSF due to the 'full containment' construction of the walls – e.g. in the event of lots of rain. Therefore, no large return water dam is required;
- Clear water from the TSF will be routed via a series of penstocks and drains to a return water sump from where it will be pumped back to the process water dams of the two concentrator plants;
- The catchment area of this dam is fairly small. Nevertheless, where necessary and practical, water diversion channels will be used to reduce storm water ingress into the dam;
- Since the dam is a 'full containment' design, the top surface of the tailings should always remain wet, thus minimising dust generation during operation of the dam;
- A series of drains will be included along the inside and outside of the walls to minimise water seeping into the walls and escaping from the dam;
- Tailings will be transported via a tailings delivery scheme consisting of pumps, a pipeline, agitator tank and booster pump station at the tailings facility; and
- Return water will be decanted, recycled and pumped back to the plant. It is estimated that 35% of the water will be recovered.

The TSF has been designed to accommodate a volumetric storage capacity of 85 836 000 dry tonnes, corresponding to 61 311 000 m^3, over a 26 year Life of Mine and comprises the following facilities:

- A Tailings Storage Facility;
- A Return Water Sump; and
- Associated infrastructure (i.e. slurry delivery infrastructure, storm water diversion trenches, etc.).

The key design features of the TSF are:

- The TSF will be constructed as a valley impoundment dam with a compacted earth embankment wall. This will have the following features:
  - The TSF will be constructed as a downstream facility;
  - The wall is to be raised in 8 phases, where Phase 1 is at elevation 1 440 m.a.m.s.l. and the last phase is at elevation 1 478 m.a.m.s.l.; and
  - The TSF has a total footprint area of 495 ha, a maximum height of 48 m and a final rate of rise of <1 m/year;
  - A concrete lined RWS with a water storage capacity of 20 000 m^3; and
  - A slurry spigot pipeline along the crest of the TSF.

The preparatory works associated with the TSF comprise the following:

- Topsoil stripping to a depth of 300 mm beneath the TSF footprint;
- Termite mounds must be removed under the wall area. This will comprise:

  - Demolition of the above ground structure;
  - A 2 m deep excavation below ground level; and
  - Excavation is to be backfilled with selected material and compacted.
- A box cut to a depth of 500 mm beneath the starter wall embankment;
- A compacted key below the Phase 1 wall embankment comprises the following:
  - Depth required shall be deep enough to remove the Kalahari sands layer;
  - 10.0 m wide;
  - 1V:1.5H side slopes; and
  - 3.5 m wide compacted bentonite-enriched earth layer to prevent excessive seepage under the wall.
- A compacted earth embankment with the following dimensions (Phase 1):
  - 10 m high (i.e. crest elevation of 1 440 m.a.m.s.l.);
  - 15.0 m crest width;
  - 1V:1.5H internal side slope; and
  - 1V:2H external side slope.
- A Curtain Drain inside the impoundment wall, to reduce the phreatic surface through the wall. This will comprise the following:
  - Starting 1 m below the top of the wall, ending at the base of the wall and 1 m wide. This will comprise of filter material;
  - A 160 mm perforated pipe at the base of the curtain drain;
  - A 160 mm non-perforated outlet pipe, conveying water out of the wall;
  - A 300 mm non-perforated pipe to convey water to the RWS; and
  - Manholes at each outlet pipe to monitor the drain flows.
- A storm water run-off trench and berm around the TSF from which water is directed away from the TSF. The trapezoidal solution trench has the following dimensions:
  - 1.0 m deep;
  - 1.0 m wide; and
  - 1V:1.5H side slopes.
- A storm water diversion channel with its associated cut-to-fill berm wall with the following dimensions:
  - 1.0 m deep;
  - 1.0 m wide; and
  - 1V:1.5H side slopes.
- A buried 900 ND Class 150D spigot-socket precast concrete penstock pipeline composed of single intermediate intakes and a double final vertical 510 ND precast concrete penstock ring inlet;

- A 1 500 micron liner along the bottom of the valley and approximately 200 m wide, in order to prevent tailings water seeping through the highly permeable Kalahari sands;
- A 315 ND slurry spigot pipeline along the length of the TSF impoundment wall; and
- A two-compartment reinforced concrete RWS.

The specified size of the penstock pipeline and the slurry delivery pipeline has been based on preliminary design calculations and should be re-evaluated during the next phase of the project.

As no stability analyses have been conducted in this stage of this project, the configuration of the TSF side slopes will need to be re-evaluated in the next phase of the project.

Retention Pond/Return Water Sump

The RWS has been designed to temporarily store water for pumping back to the plant. The bulk of the supernatant water will be stored on the TSF due to it being an engineered impoundment wall. The penstock will allow return water to gravity feed into the RWS from where it will be pumped back to the process plant for reuse.

The RWS will be concrete lined with twin compartments. The purpose of the twin compartments is to allow desilting of the one while still operating the other compartment. The twin compartments of are each equipped with separate inlet spillways and outlet pipes, which facilitate alternate cleaning and operation of each compartment. A third compartment will be provided for the pumps, with pipes leading out of the twin compartments and into the pumping compartment.

Properties of the Tailings used to develop the TSF Design

The properties of the Tailings used to develop the TSF Design are presented in Table 21

Table 21: TSF Design Criteria (EPOCH 2016)

Description	Value	Unit
Particle Specific Gravity	2.85	
In-Situ Void Ratio	1	
Particle Size Distribution	80% passing 53 µm sieve	
Placement Dry Density of Tailings: Sub-aqueous Sub-aerial Average	 1.3 1.5 1.4	 t/m^3 t/m^3 t/m^3

Level of Stability

The slope stability factor of safety has been deigned for greater than 1.5 for static analysis and between 1.1 and 1.3 for pseudo-static analysis.

3.13 Transport

3.13.1 Property Access

The city of Lubumbashi, located 290 km east of the Kamoa Copper SA Project, can be accessed by an international airfield. Alternatively, the Zambian city of Ndola, which also has an international airfield, can be used. Ndola is located approximately 200 km south-east of Lubumbashi.

The closest major township to the Project is Kolwezi. There are regular flights between Lubumbashi to Kolwezi, with the flying time being approximately 45 minutes.

Kolwezi is connected by road to Likasi and Lubumbashi. Travel time by car from Kolwezi to Lubumbashi is currently 4 to 5 hours. The route is a combination of tarred and gravel roads, which have recently been refurbished and are in reasonable condition.

Access to the Project area from Kolwezi is via unsealed roads to the villages of Israel, Muvunda and Musokantanda. The road network throughout the Project has been and will continue to be upgraded by Kamoa Copper SA to provide reliable drill and logistical access.

New access roads are to be developed for the Project. Figure 2 illustrates the proposed path of the new road developments directly from the Kolwezi Airport and as follows:

- The distance will be 36 km and 40 km from Kansoko and Kakula respectively;
- This road will be used for import/export logistics and for employee commuter buses between the mine sites and Kolwezi;
- This road will be 11 m wide gravel road, on a 55 m wide servitude, designed for 80 km/h;
- The road may be surfaced later in the Project life;
- The road will join the provincial road planned by Lualaba Provincial government to connect Kolwezi with Solwezi;
- The road will be open for public access;
- Kamoa Copper SA will be responsible for maintaining the road;
- Nobody will be allowed to construct anything inside the 55 m servitude; and
- The existing road between Luilu and Kamoa will be retained as a second access route.

In addition, each mine site will also have a truck park for 500 trucks waiting to offload, load or complete documentation. Truck parks will have ablution and basic shop facilities for drivers.During the initial phase of the project, all transport of goods and people to and from site is planned to be by road. Later in the project rail transport may be considered (rail is not considered in this EIS).Trucks importing and exporting goods will travel via Lubumbashi and Kasumbalesa border post. There will be 2 main access routes to site:- the existing one from Kolwezi via Luilu and a new road planned south of Kolwezi from the airport directly to Kamoa. The new road will enable faster travel between Kolwezi and Kamoa and also allow trucks to- and from Kamoa to avoid travelling through Kolwezi town. Below is a list of traffic expected on the roads between Kolwezi and Kamoa:

- Imported Construction Materials: 150 ‘superlink’ or ‘triaxle’ trucks per month during peak construction activities;
- Local Construction Materials (Mainly sand and stone): 300 rigid dump trucks per month during peak construction;
- Concentrate Product (Mainly exported): 2,000 trucks per month (700,000 tons per annum);
- Imported Operational Consumables: 200 trucks per month;

- Busses: 20 Busses per day during peak construction and operations; and
- Light vehicles: 200 Light vehicles per day during peak construction and operations.

TITLE III: ANALYZING THE ENVIRONMENTAL SYSTEM AFFECTED BY THE PROJECT

4.0 CHAPTER I: COMPONENTS OF AN ENVIRONMENTAL SYSTEM

4.1 Obligation to analyse the components of the environmental system

The applicant for a mine or permanent quarry exploitation right analyses the biophysical and sociological components of the environmental system affected by the project as they exist before the project is set up.

This section provides an overview of the physical, biological and socio-economic environment which may be affected by the Project.

4.2 References

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5.0 CHAPTER II: PHYSICAL ENVIRONMENT DESCRIPTION

5.1 Topography, geology and land use

5.1.1 Topography

The topography and geology of within the mining license perimeter is illustrated in Figure 27 and Figure 28. A north-north-east to south-south-west trending ridge dominates the topography and is incised by numerous poorly to well-developed drainage systems. The regional elevation ranges from 1,030 to 1,540 m above mean sea level (amsl) and the area is characterised by a series of undulating ridges with incised open valleys.

Elevation of project areas within the perimeter of the mining license range from 1,300 to 1,540 amsl, with current exploration activities in areas of elevation from 1,450 m to 1,540 m amsl. Local topography is affected by the drainage catchments of the Luilu, Mukanga, Kamoa, Lulua, Chamilundu, Luvumbani, Kabitungu and Kalemba Rivers and the Kalundu, Kansoko and Kabulo Streams The landscape is dominated by Dambo (local name for low-lying valley related wetlands) and Dilungu (local name for Kalahari sand plateau).

5.1.2 Geology

The Project lies within the interpreted extension of the Western Foreland unit of north-western Zambia (Key, 2001) and the basement geology is characterised by Kibaran Group metasedimentary rocks. Geological mapping and magnetic data indicate that the majority of the Foreland is underlain at surface by the Grand Conglomerate Diamictite (Figure 28). This unit constitutes a regional exploration target, as the base of the Diamictite is considered a regionally-prospective redox boundary. The discovered Zambian Copperbelt-style copper mineralisation is believed to represent the first discovery of copper mineralisation west of the External Fold and Thrust Belt that hosts the operating mines of the Congolese sector of the Copperbelt.

The majority of the Project area lies on a broad, gentle plateau between two major north-north-east trending structures. To the east, and identified primarily by airborne magnetics, is the Kansoko Trend which is the interpreted boundary with the External Fold and Thrust Belt. The geology of the Kansoko Trend is currently poorly defined. To the west is a prominent escarpment and magnetic feature named the West Scarp Fault.

Between these structures a series of gentle domes occur, where the Grand Conglomerate is eroded, and the underlying Roan sandstones are exposed.

The margin of the northernmost Kamoa dome was the site of Ivanhoe Mines' initial discovery of copper mineralisation. In contrast to the rest of the Katangan Copperbelt, the stratigraphy of the Kamoa area is carbonate-poor and lacks the megabreccias characteristic of the Roan sequence. Three major structural blocks identified in the Kamoa area include:

- A deep graben (or half graben) to the west of the West Scarp Fault. This is in-filled by Lower Kundelungu Diamictite (Grand Conglomerate) and associated sediments which probably rest unconformably upon andesitic/mafic igneous and volcanic rocks in parts of Exploration Permit 704. The downward displacement of the West Scarp Fault is approximately 350 to 400 m;
- An area between the West Scarp Fault and Kansoko Trend, where the domes occur. The domes comprise Roan-age, medium- to coarse grained feldspathic sandstone and siliciclastic rocks (footwall feldspathic sandstone- RFS), which in the north pass downwards into pebble immature grits and conglomerates; and
- A north-north-east to south-south-west-trending belt, the Kansoko Trend, approximately 3 km wide commencing approximately 1 km to 2 km east of the Kamoa and Makalu domes. This belt is underlain by a thick, easterly-dipping sequence of weakly carbonaceous and pyrrhotite-bearing Diamictite and siltstone with subordinate andesitic (or mafic), sill-like bodies towards the north-east.

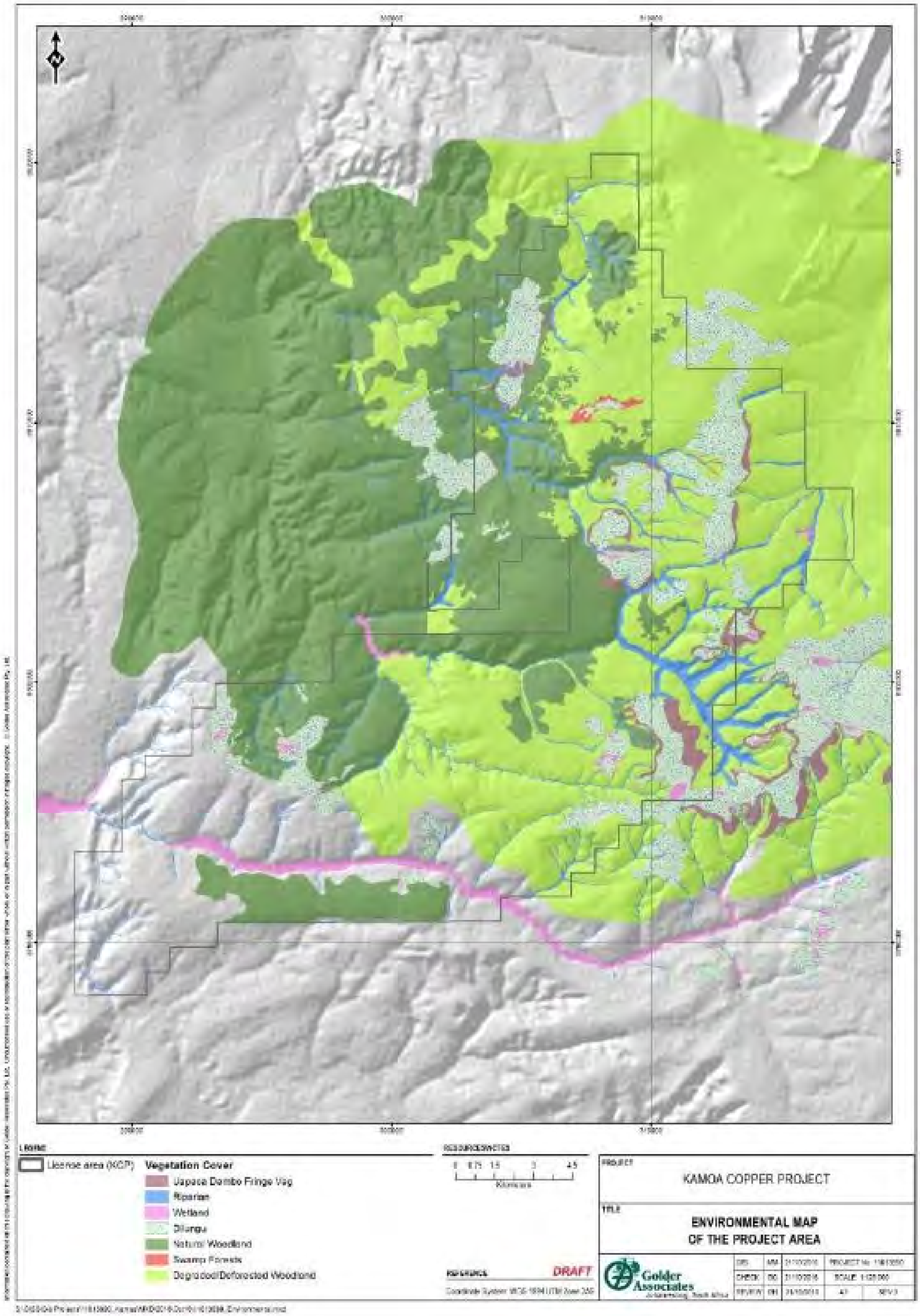


Figure 27: Topographical Map of the Project Area

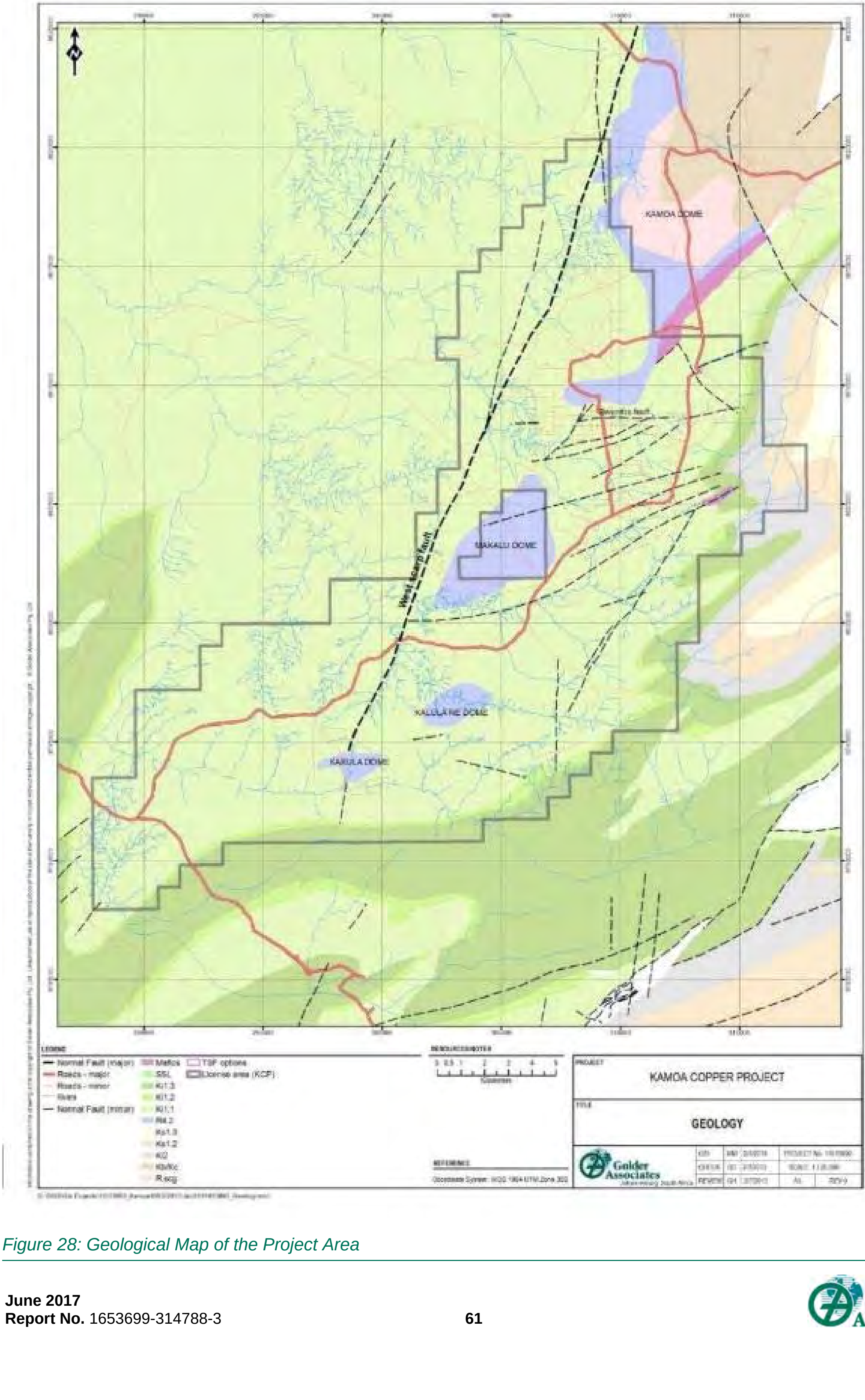


Figure 28: Geological Map of the Project Area

5.1.3 Soils Utilisation

The dominant soil types within the Project Area are differentiated according to distinct land types, namely the hilly regions, the wet plains (Dilungu and Dambos) and miombo forest (Figure 32).

In the hilly regions, Leptosols and/or Regosols and Cambisols result due to the uneven shape of the landscape which prevents the weathering of the regolith. Leptosols or Regosols (shallow soils) occur over hard rock. Cambisols which are young soils with a very recent horizon differentiation with evident changes in colour or structure are located on the foot of slopes.

Within the Dilungu landscape (wet plains), plateaus and valleys, Arenosols and Plinthosols are predominant, with scattered occurrences of highly weathered soils like Ferralsols, Acrisols and Alisols. Arenosols are mostly developed through Kalahari sand deposits and/or in the residual sands. Plinthosols are developed where there is plinthite, which is an iron-rich, humus-poor mixture of koalinitic with quartz and other constituents such as conglomerates, which changes irreversibly to a hard pan or to irregular aggregates on exposure to repeated wetting and drying. Iron is present, originating either from the parent material itself or brought in by seepage water from elsewhere.

Also occurring in the depressions of the Dilungu landscapes are Haplic Podzols, which have a typically ash-grey upper subsurface horizon, bleached by loss of organic matter and iron oxides, on top of a dark accumulation horizon with brown, reddish or black illuviated humus and/or reddish Fe compounds.

In the miombo forest, highly weathered Acrisols, Alisols and Ferralsols have been observed. Acrisols are characterised by accumulation of low activity clays in argic subsurface horizons and by low base saturation levels, mostly on old surfaces with hilly or undulating topography. Alisols consist of strongly acidic soils with accumulated high activity clays in the subsurface that have more than 50 percent Al^{3+} saturation, most common in old land surface with undulating topography. Ferralsols occur on plateaus and consist of deep and intensively weathered soils, with low CEC values and base saturation, and almost completely devoid of weathered minerals.

Hydromorphic

Hydromorphic soils[1] within the perimeter of the mine lease include Haplic Podzols, Arenosols, and Plinthosols in the Dilungu and Dambo areas (Figure 29, Figure 30, and Figure 31).

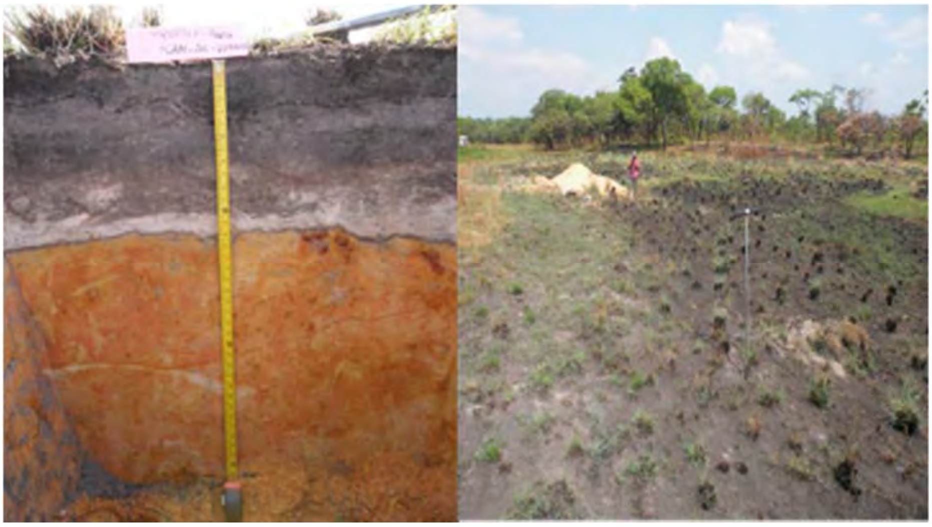


Figure 29: Soil profile and its environment on Haplic Podzols at proposed TSF option -1 at Venance Dilungu

[1] Soils associated with marshes, swamps, bogs, or poorly drained flat uplands. All are considered intrazonal soils because of poor drainage.

Figure 30: Soil profile and its environment on Plinthic Arenosols in the Tshamadingi area

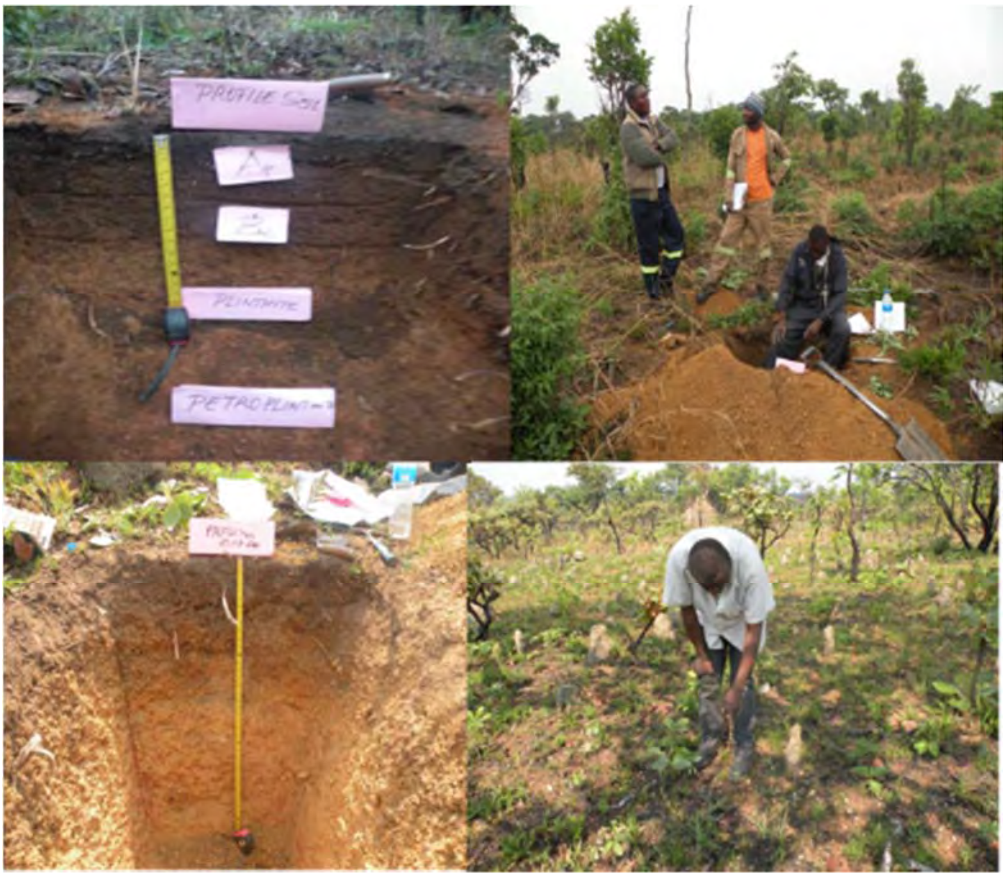


Figure 31: Soil profile and its environment on Haplic Plinthosols under natural vegetation

Alluvially deposited non-climatic soils

Alluvially deposited non-climatic soils have not been observed in the mining lease area.

Land use

Land use generally correlates to soil types and topography but is also influenced by access to water, access to roads and proximity to major settlements such as of Kolwezi. Most of those soils in hilly areas and Dilungus remain under natural vegetation. The main traditional land uses include subsistence cropping (predominantly cassava, which is a less demanding crop for the poor and depleted soils) and logging of wood for charcoal production. The latter activity has experienced a recent and rapid increase in scale driven by the constant demand for charcoal in the city of Kolwezi. Both the cropping and logging land uses impose a significant risk to extensive soil erosion and soil degradation.

The following linkages between soil type and land use in the Project Area are presented in Table 22:

Table 22: Soil use

Type of Soil	Use
Leptosols, and Regosols	Little cropping activity due to poor rooting conditions, very steep slopes, difficult workability and their sensitivity to erosion.
Cambisols	Readily being utilised for cropping. The less fertile areas of Cambisols remain as they are much less desirable for cropping owing to such factors as steep slopes, shallow soils and stoniness. Vegetation removal through charcoal production on these soils poses a significant risk of extensive soil erosion.
Arenosols and Plinthosols	Inherently infertile and unproductive for cropping. Arenosols are widespread, occurring on Dilungu landforms and/or some Dambos on Kalahari sand. The majority of the Dilungus are not under cultivation and are generally under natural conditions.
Alisols	Charcoal production is the main land use on these soils, with some cropping activities.
Podzols	Offer little value for agriculture or logging activities.
Ferralsols	Much of the cropping in the Project Area occur on Ferralsols. However, loss of organic matter through current farming practices and wildfires is causing a rapid decline in soil fertility.

The Project will utilise approximately 30% of the mining lease area for mining activities (industrial land use) with ~1% used for farming projects for maize and fish ponds.

Approximately 18.2% of land has moderate agricultural potential (IV), roughly 31% is suitable for agriculture with fertilizer, and the reaming 50% of land (category VI) generally has poor agricultural potential (depending on physical and chemical characteristics of fertility linked to the topography), see Figure 33. By extrapolation, agriculture would be appropriate for ~18.2% of the land area, animal husbandry would be appropriate for ~31% and ~50% of land would be more suited to industry or commercial activities.

Table 23 provides an estimate of the landuse coverage across the Kamoa project area.

Table 23: Estimate of landuse percentages

Type of landuse	Percentage coverage	Type and purpose of activity	Timing
Mining	30%	Copper mining by Kamoa SA	Permanent
Agriculture	18%	Subsistence farming	Seasonal
Animal Husbandry		Subsistence farming	Permanent
Industry	0%	Not applicable	Not applicable
Commercial activities	2%	Market and shops	Permanent
Residential	2%	Local community villages	Permanent
Natural	48%	Utilised for hunting, charcoal burning and gathering of fruit, forest, savanna shrub	Permanent

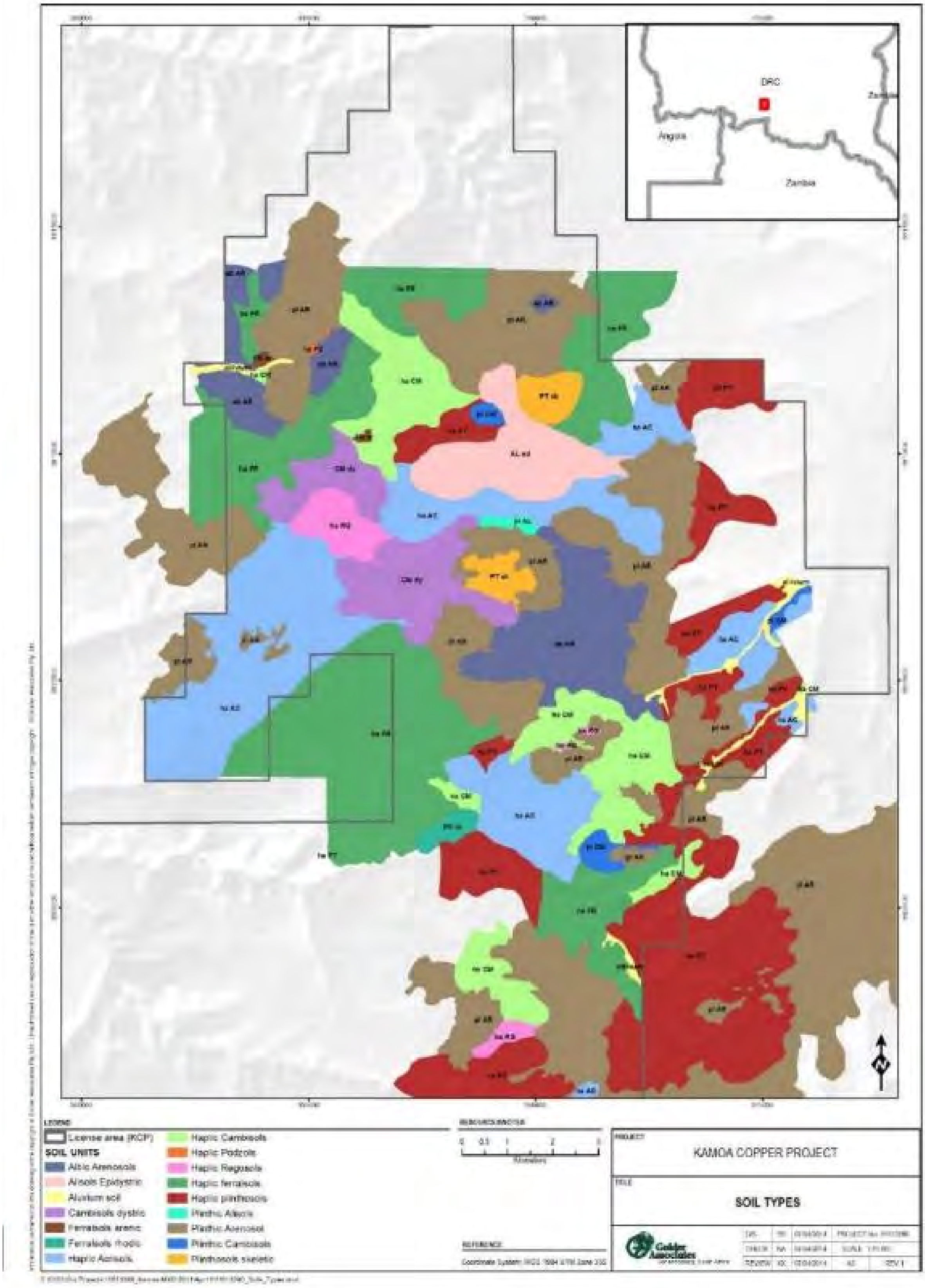


Figure 32: Soils Map of the Study Area

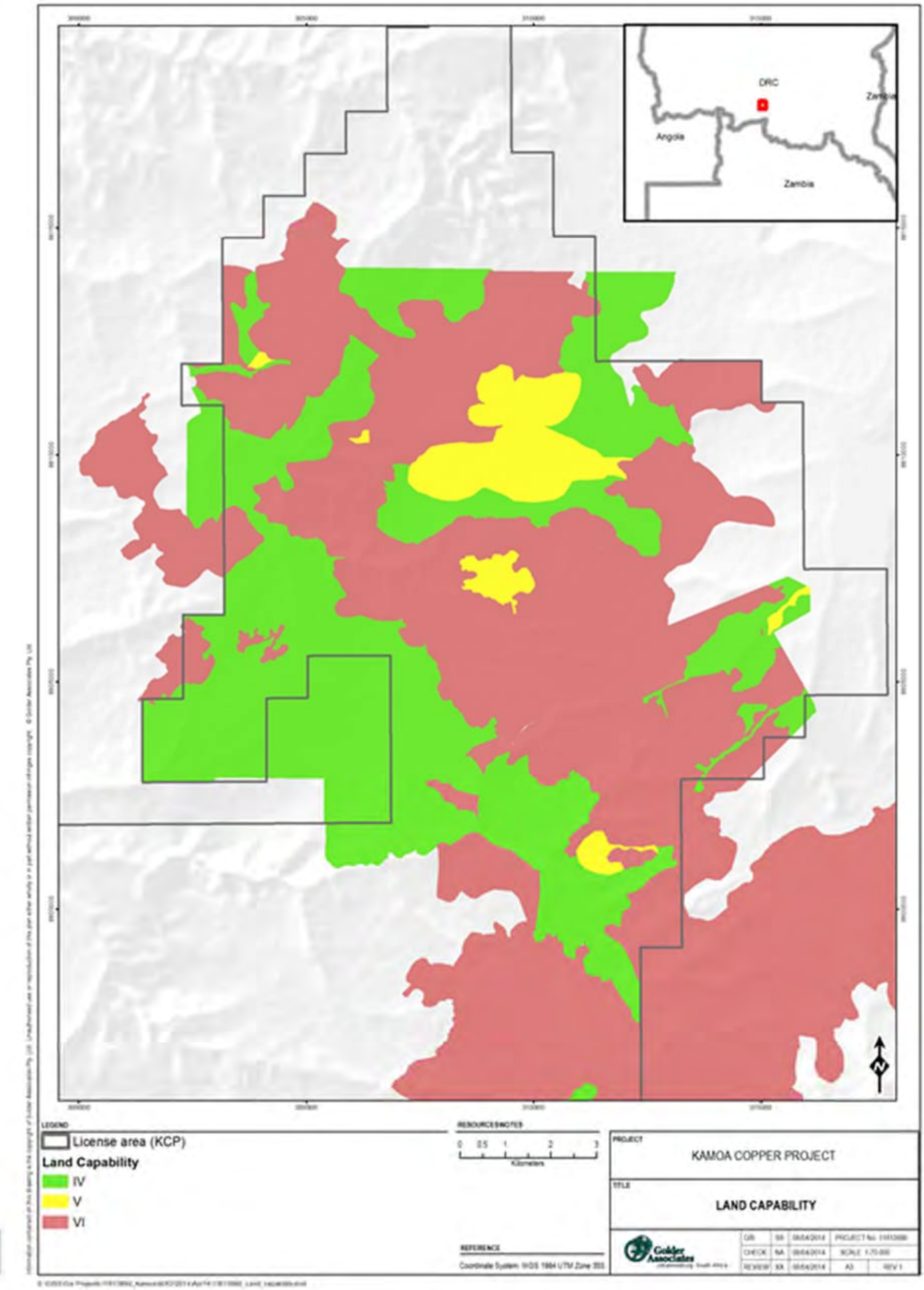


Figure 33: Land Capability

5.1.4 Areas subject to erosion and desertification

Potential areas susceptible to erosion and desertification are shown in red in Figure 34. Orange areas indicate land that is susceptible to arid or semi-arid conditions, while green areas reflect moderately deep soil profiles not associated with erosion or desertification. In terms of soil erosion, all soil in the hillier landscapes such as Regosols and some of Cambisols suffer from very serious land sensitivity. Arenosols (particularly in the Dilungus) are extremely sensitive to erosion (gully erosion is evident in places). Wherever roads in have been built on Dilungus, serious erosion is likely to occur even though roads are covered by laterite layer resulting in loss of topsoil or/and subsoil and desertification of the Dilungu. On the plateau landscape, almost all weatherable ferrallitique soils are ranged as moderately susceptible to erosion.

5.1.5 Risk of natural disasters

The risk of natural disasters such as earthquakes, landslides and landslips in the region where the Project perimeter is located is rated as low/unlikely.

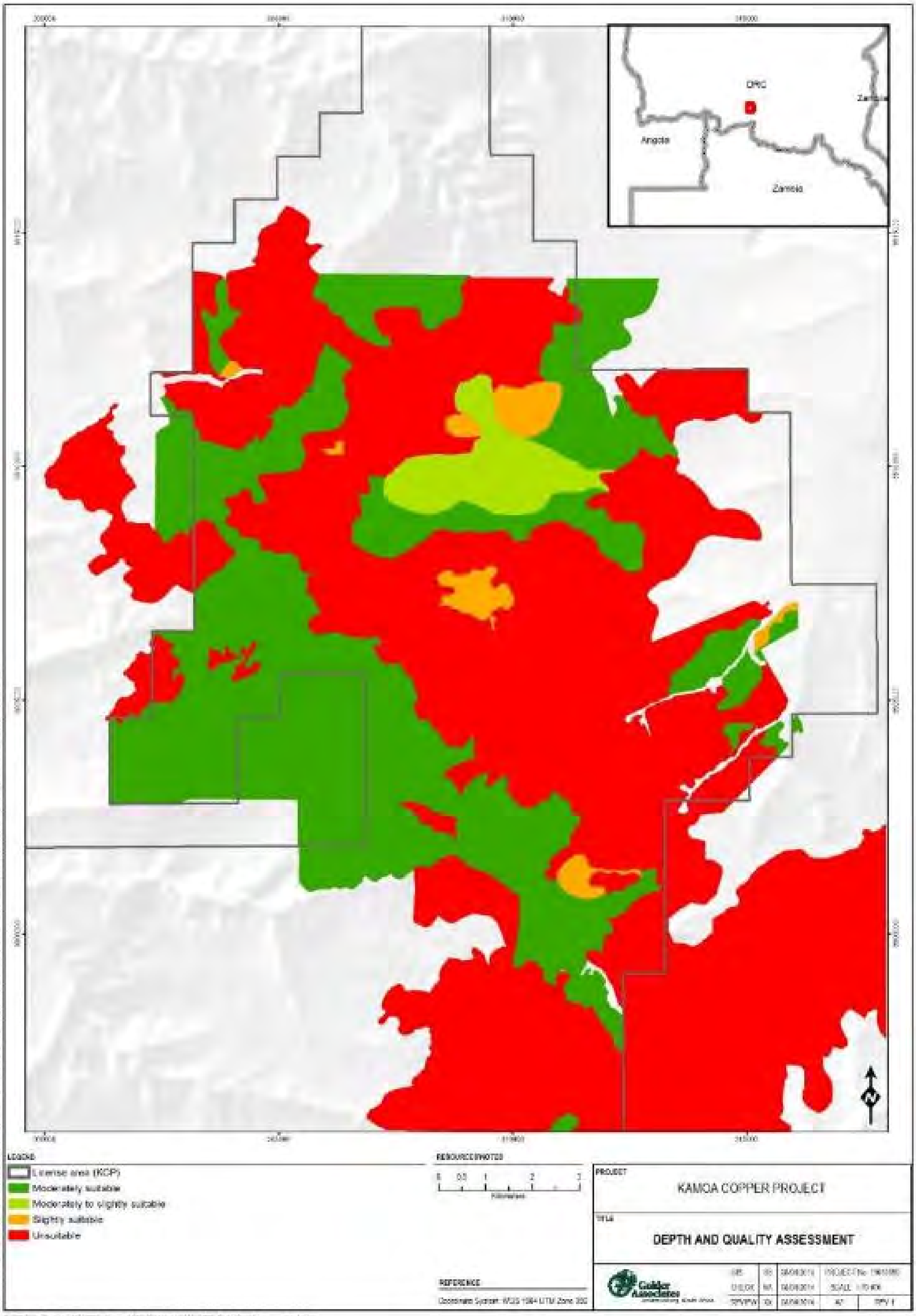


Figure 34: Depth and quality of soil

5.2 Climate and Air Quality

There are four main sources of meteorological data within the Project area:

- Weather station at the Kolwezi Airport (35 km to the east of the site);
- Meteorological station of the Kamoa camp;
- Kaponda village rain gauge; and
- Kalundu village rain gauge.

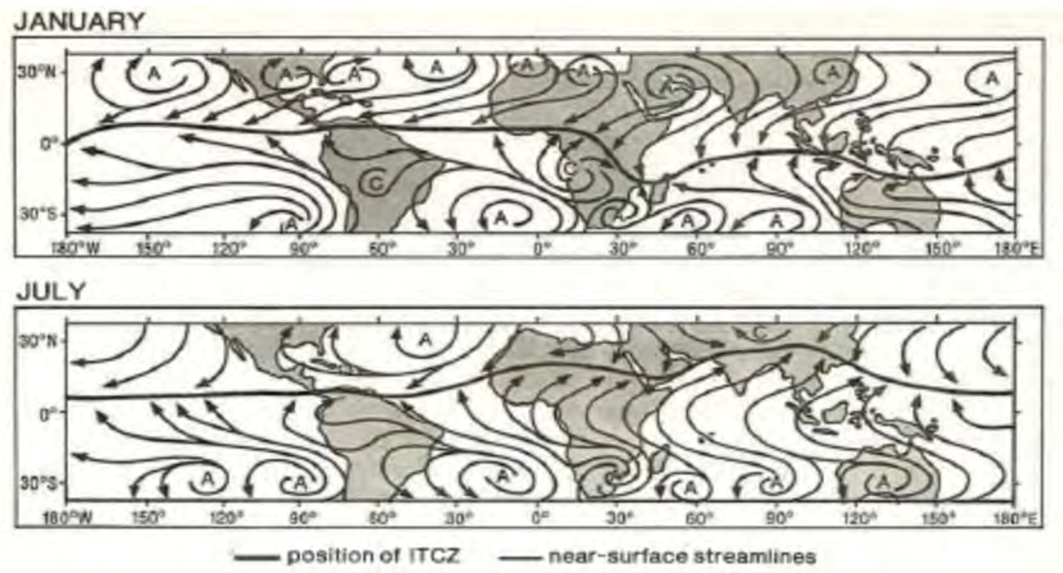
The climate prevailing in the perimeter of Kamoa is of hot temperate type, with a corresponding Koppen index of Cw6. It is featured by the alternation of two seasons:

- The 6 - month dry season which runs from 15 April to 15 October with relatively low temperatures, the minimum of which varies between 10 and 15°C; but they can also go down to 5ºC at night, during the months of July and August; and
- The 6 - month rainy season which begins on 15 October and ends in mid - April, with relatively high temperatures oscillating between 22 - 30°C. This season is also feautured by rainfall records, especially in November and December.

5.3 Regional climate

Inter-Tropical Convergence Zone (ITCZ)

Most of DRC (and Kamoa) lies within the Inter-Tropical Convergence Zone (ITCZ) within a band of approximately 10 degrees either side of the equator. The mean circulation patterns in this area are dominated by the tropical easterly flows that converge around the equator. Throughout the year the ITCZ shifts, over Africa, it migrates from the southern hemisphere to the northern hemisphere during the months of January to July (Preston-Whyte and Tyson, 1997). When the easterly flows cross the equator from north to south, the Coriolis effect causes the flows to deflect from left to right (Note: When crossing south to north the effect is reversed and deflection is right to left), resulting in an immediate re-curvature of the flow such that the winds acquire a westerly component, as is shown over Africa in July (Note: *A indicates anticyclonic centres and C denotes cyclonic centres.*



Note: A indicates anticyclonic centres and C denotes cyclonic centres.

Figure 35: Schematic representation of the near surface flow in the ITCZ during January and July (Preston-Whyte and Tyson, 1997)

The ITCZ is a zone of pronounced convective activity with well-defined regions of ascent and associated regional subsidence. Rainfall in the ITCZ is brought about and controlled by conditional instability, the penetration of mid-latitude disturbances into the tropics and forcing by sub-synoptic meso-scale disturbances (Preston-Whyte and Tyson, 1997). The air that is forced upward is cooled, and the resulting condensation produces prolonged and heavy seasonal precipitation.

Climate regions

Two broad climatic regions can be distinguished in the DRC (SRK, 2008). The Congo River basin, which lies on the equator and forms approximately half of the country's area, consists of low-lying rain forest, which receives rainfall all year round. Temperatures are not as high as may be expected for an equatorial region, but humidity is generally high.

The remainder of the country, comprising of the areas around the Kinshasa, Kivu, Kasai and Katanga provinces, all experiences distinct rainy and dry seasons. Katanga province lies at an approximate elevation of 1 000 m and greater, experiences a very agreeable climate with cooler, drier air than the majority of the country (SRK, 2008).

The climate in the project area is warm and temperate. The summers here have a good deal of rainfall, while the winters have very little. This climate is classified as Cwa (warm temperate, dry winters, hot summers) according to the Köppen-Geiger climate classification.

The average temperature for the year in Kolwezi is 20.6°C. The warmest month, on average, is October with an average temperature of 22.8°. The coolest month on average is June, with an average temperature of 17.8°C. The highest recorded temperature in Kolwezi is 33.3°C, which was recorded in October. The lowest recorded temperature in Kolwezi is 6.7°C, which was recorded in June.

The average amount of precipitation for the year in Kolwezi is 1 163.3 mm. The month with the most precipitation on average is November with 259.1 mm of precipitation. The month with the least precipitation on average is June with an average of 0 mm. In terms of liquid precipitation, there are an average of 55.5 days of rain, with the most rain occurring in November with 14.0 days of rain, and the least rain occurring in June with 0.0 days of rain (Table 24) (Source - http://www.weatherbase.com). The majority of rainfall events occur during the period of October through to March (the wet season), and the dry season occurs from April to September. Based on the observed precipitation data for the Kolwezi meteorological station for the period 2004 to 2010, a distinctive seasonal precipitation pattern is displayed (Figure 36).

Note: The wet season typically coincides with the change in prevailing wind direction from the south-south-east and south-east to the north and north-north-west.

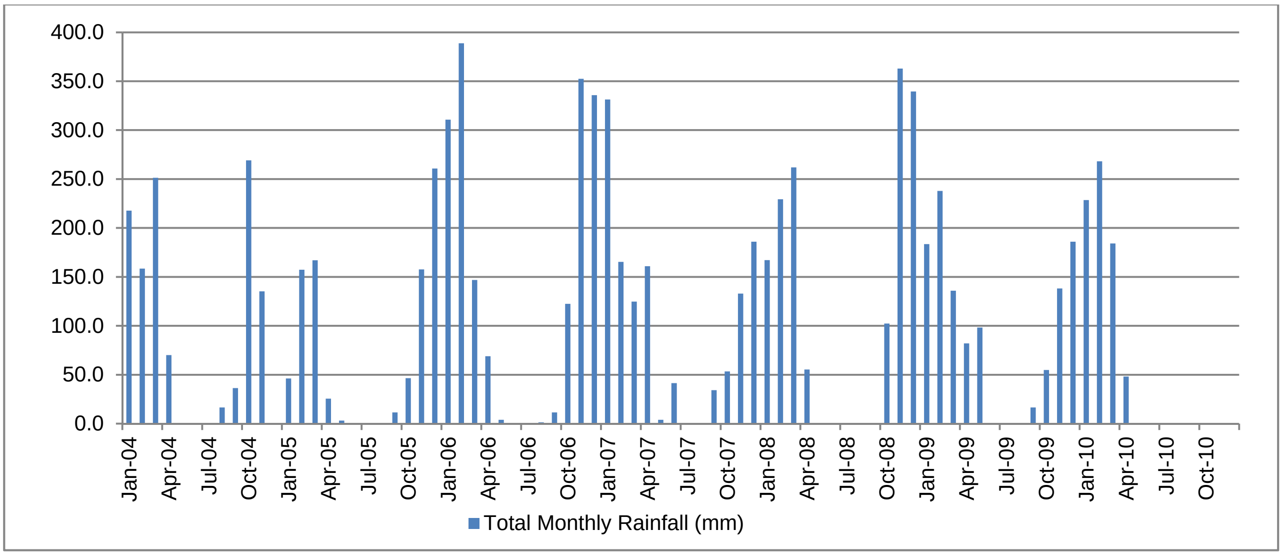


Figure 36: Precipitation for Kolwezi for the period 2004 to 2010

Table 24: Local climate (Source - http://www.weatherbase.com)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Average High (°C)	26.0	27.0	27.0	27.0	27.0	25.0	26.0	28.0	30.0	30.0	27.0	26.0	27.0
Temperature Average (°C)	21.0	21.5	21.5	21.0	20.0	18.0	18.5	20.5	22.0	23.0	21.5	21.0	20.5
Temperature Average Low (°C)	16.0	16.0	16.0	15.0	13.0	11.0	11.0	13.0	14.0	16.0	16.0	16.0	14.0
Average Precipitation (mm)	132	165	230	66	5	0	0	0	5	66	259	236	1163

5.4 Meteorology

The Penn State University (PSU) / National Centre for Atmospheric Research (NCAR) meso-scale model is a limited-area, non-hydrostatic or hydrostatic (Version 2 only), terrain-following sigma-coordinate model designed to simulate or predict meso-scale and regional-scale atmospheric circulation. It has been developed at PSU and NCAR as a community meso-scale model and is continuously being improved by contributions from users at several universities and government laboratories. The Fifth-Generation PSU/ NCAR Meso-scale Model is known as MM5 (PSU/NCAR).

MM5 data for the period 01 January to 2007 to the 31 December 2015 was obtained for the purposes of this study, it is assumed to be representative of meteorological conditions in the KCP concession area.

5.4.1 Wind Roses

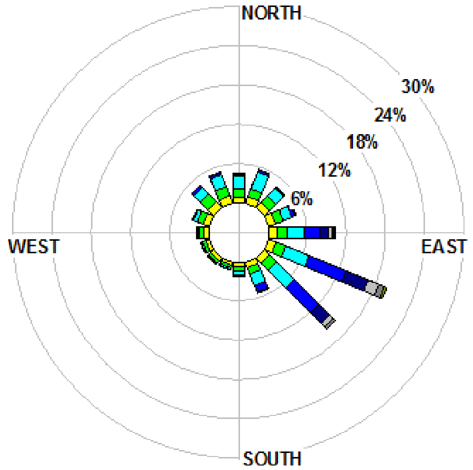
Wind roses summarise the occurrence of winds at a specified location by representing their strength, direction and frequency.

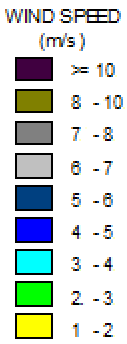
Calm conditions are defined as wind speeds of less than 1 m per second (m/s) which are represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions). Each cardinal branch is divided into segments of different colours which represent different wind speed classes. Each circle represents a percentage frequency of occurrence.

The dominant wind sector in the project area is east to south-east, with the north-west to east-south-east sector dominating during the wet season and the east to south-south-east sector dominating during the dry season (Figure 37 and Figure 38).

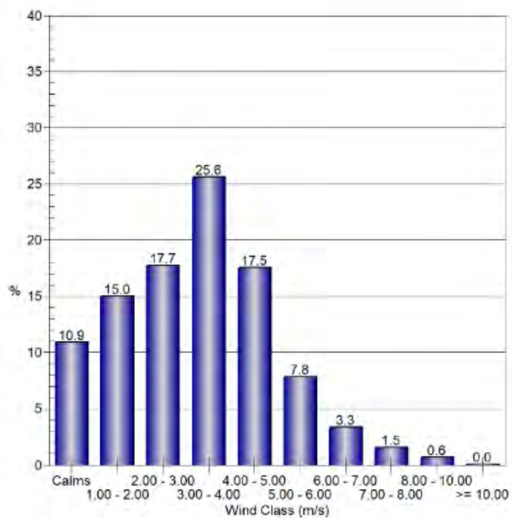
KCP 2007 - 2015

Wind Rose

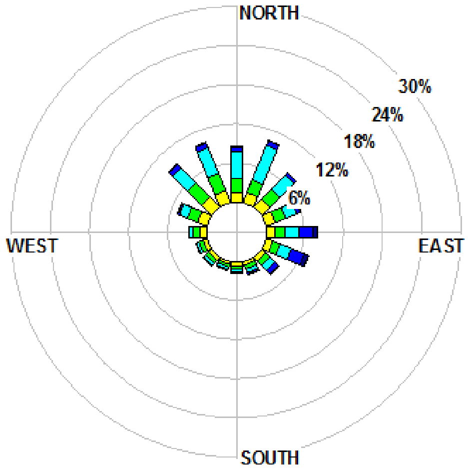




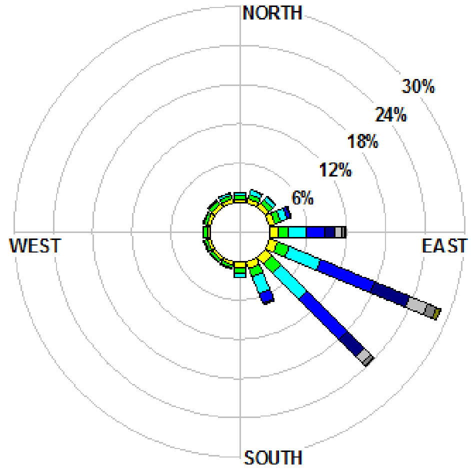
Wind Classes



Wind Rose - Wet Season (November – March)

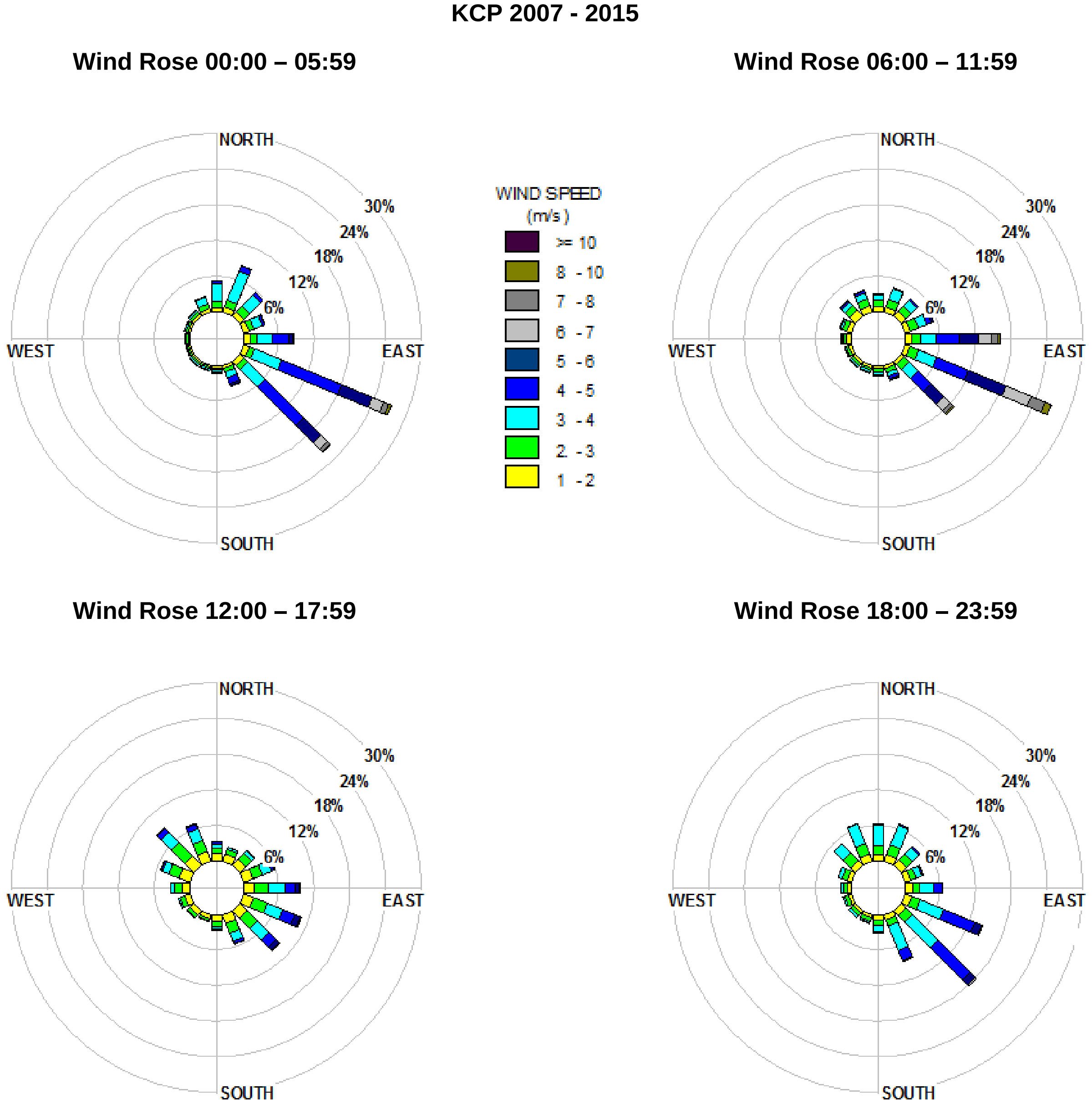


Wind Rose - Dry Season (April - October)



Period	Wind Speed	Missing Data	Calms	Dominant Sector		Dominant Sector	
2007 to 2015	3.0 m./s	0.0%	10.9%	E-SE	50%	-	-
Wet	2.4 m/s	0.0%	13.7%	NW-ESE	76%	-	-
Dry	3.5 m/s	0.0%	8.9%	E-SSE	77%	-	-

Figure 37: Period and seasonal wind roses



Time	Wind Speed	Missing Data	Calms	Dominant Sector		Dominant Sector	
00-05	3.5 m/s	0.0%	6.6%	NNE	9%	E-SE	61%
06-11	3.6 m/s	0.0%	8.9%	E-SE	60%	-	-
12-17	2.2 m/s	0.0%	18.6%	WNW-NNW	26%	ENE-SSE	50%
18-23	2.8 m/s	0.0%	9.4%	NNW-NNE	22%	E-SSE	51%

Figure 38: Diurnal wind-roses

5.4.2 Onsite Meteorology

KCP manages an onsite meteorological station which records hourly measurements of the following parameters:

- Wind:
  - Direction;
  - Speed; and
  - Chill.
- Temperature:
  - Average;
  - Maximum;
  - Minimum; and
  - Dew point.
- Humidity;
- Barometric Pressure;
- Precipitation;
- Solar radiation; and
- Heat index.

Valid data from this station was included where possible.

5.4.3 Meteorological disasters

Meteorological disasters such as sand or dust storms, hail, torrential rain, hurricanes, cyclones, tornadoes, flood, drought, etc. are rated as having a low probability in the Project area.

5.5 Air Quality

5.5.1 Sources of Air pollutants

Existing sources of air pollution within Kamoa have been identified to include:

- Mining activities at Musonoi and Kolwezi;
- Unpaved roads and exposed areas;
- Vehicle emissions (tailpipe and entrained emissions);
- Agricultural activities;
- Domestic fuel burning; and
- Biomass burning.

An ambient air quality monitoring campaign was undertaken from April to December 2012, 24 sites were monitored for:

- Particulate matter (dust-fallout);
- Nitrogen dioxide (NO_2),
- Sulphur dioxide (SO_2); and
- Ozone (O_3).

Additional dust-fallout monitoring has also been performed, the following sub-sections outline the findings of the monitoring.

5.5.1.1 Dust-fallout

Dust fallout during the April to December 2012 campaign was found to be low and below relevant guidelines (Figure 39).

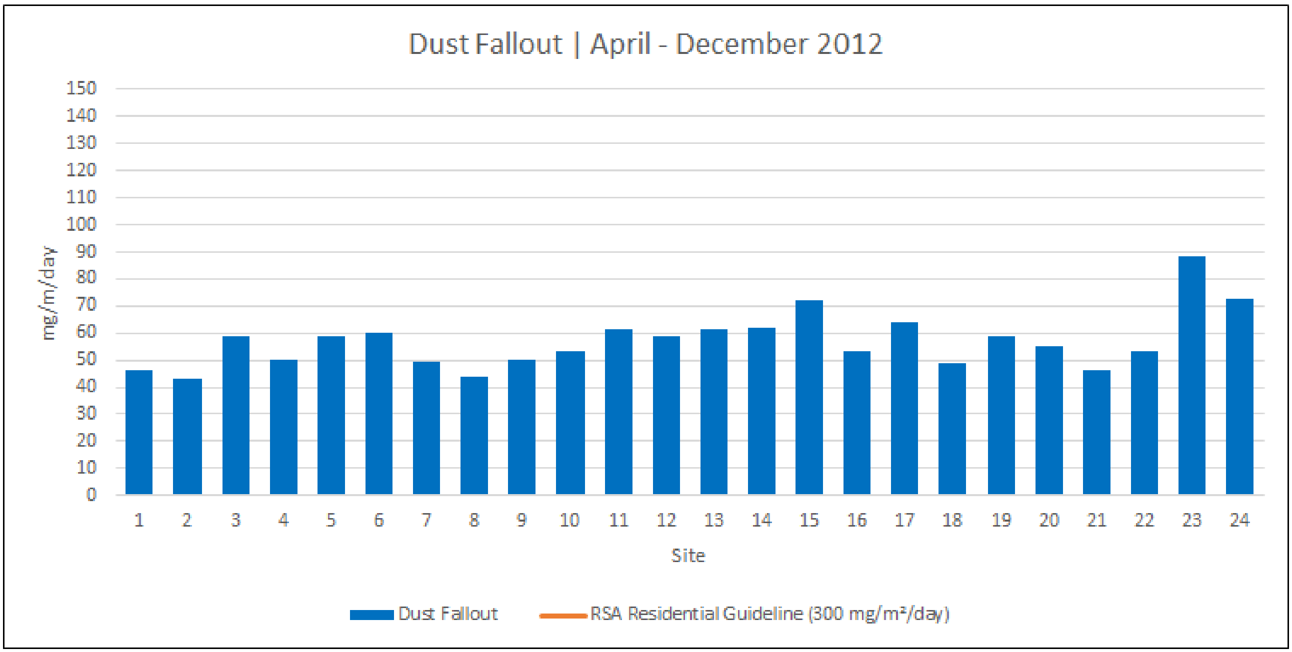


Figure 39: Dust-fallout (April – December 2012)

A summary or the additional dust fallout monitoring (2013/07/06 – 07/07/2014) is shown in Table 25 and Figure 40. Network averages for the period (Residential 170 mg/m^2/day, Industrial 55 mg/m^2/day) were below relevant guidelines.

Table 25: Dust-fallout (2013/07/06 – 07/07/2014)

Site	Residential									Industrial	Residential Network Average	Industrial Network Average	Network Recovery
	K1	K2	K3	K4	K5	K6	K7	K9	K10	K8			
06/07/2013 to 05/08/2013	126	60	66	59	52	557	54	148	54	70	131	70	100%
05/08/2013 to 05/09/2013	62	15	21	42	45	288	42	83	57	20	73	20	100%
05/09/2013 to 04/10/2013	227	141	182	**609**	158	294	258	**2050**	**1893**	147	**646**	147	100%
04/10/2013 to 05/11/2013	104	57	82	175	No Data	161	191	76	76	83	115	83	90%
05/11/2013 to 04/12/2013	51	81	22	62	No Data	103	**1060**	133	52	35	196	35	90%
04/12/2013 to 09/01/2014	No Data	36	17	43	No Data	20	15	53	17	14	29	14	80%
09/01/2014 to 10/02/2014	**1727**	10	64	7	No Data	4	45	19	57	11	242	11	90%
10/02/2014 to 12/03/2014	28	24	19	27	No Data	69	35	50	34	24	36	24	90%
12/03/2014 to 11/04/2014	64	297	25	136	44	126	29	38	41	17	89	17	100%
11/04/2014 to 09/05/2014	118	54	49	151	88	361	45	187	121	92	130	92	100%
09/05/2014 to 09/06/2014	119	138	71	81	101	379	82	227	167	73	152	73	100%
09/06/2014 to 07/07/2014	77	84	471	66	42	345	77	196	71	76	159	76	100%
Average Since 06/07/2013	246	83	91	122	76	226	161		220	55	170	55	95%

Notes: Red indicates exceedances.

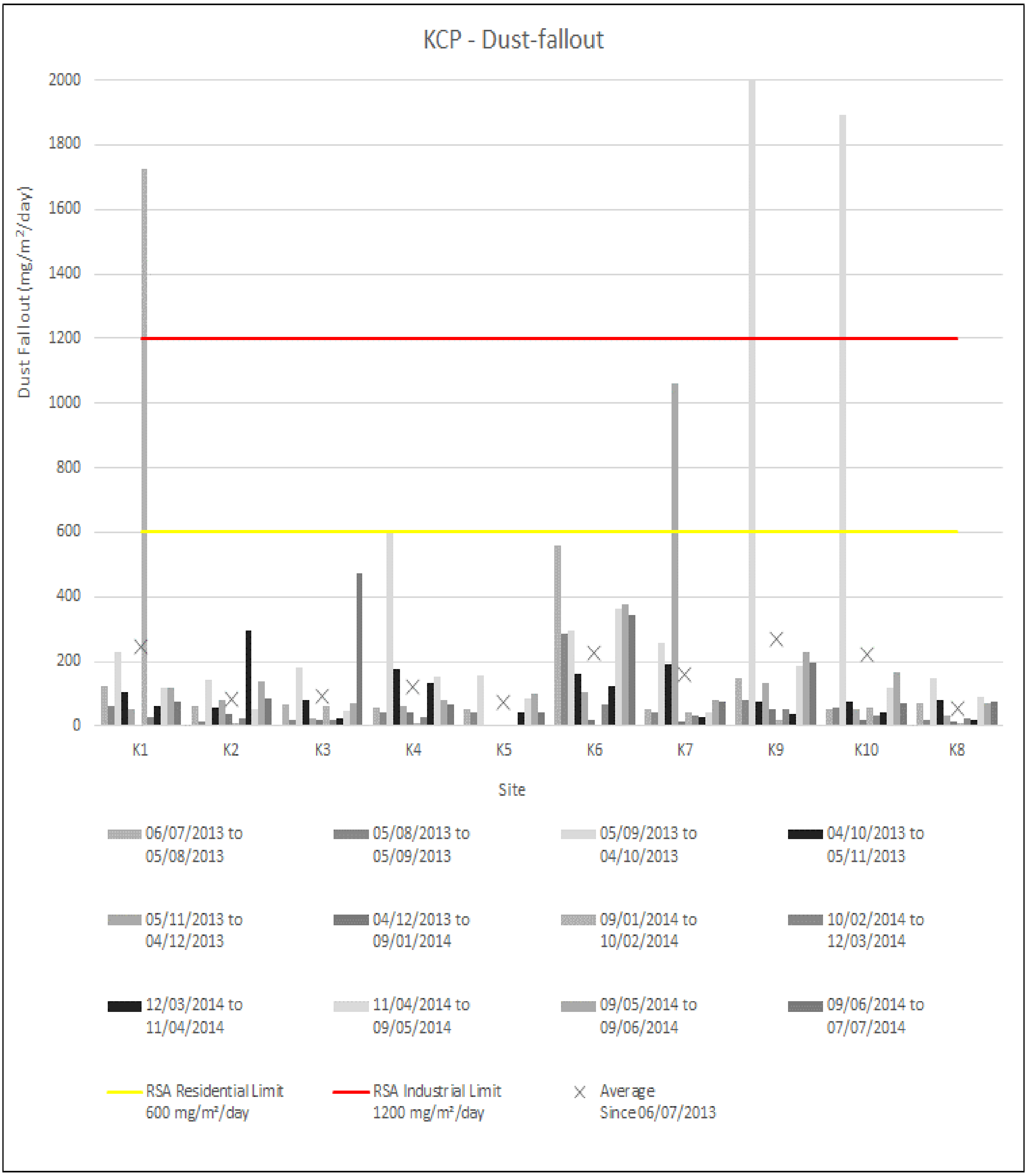


Figure 40: Dust-fallout (2013/07/06 – 07/07/2014)

5.5.1.2 Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Ozone (O_3)

Ambient NO_2, SO_2 and O_3 concentrations are illustrated in Figure 41, Figure 42 and Figure 43. Due to variable measurement lengths a conservative approach was adopted and concentrations were compared to their respective long term (annual for SO_2 and NO_2 and 8-hour for O_3) standard/guideline. Concentrations of SO_2, NO_2 and O_3 are below DRC standards Low baseline concentrations are indicative of low industrialisation.

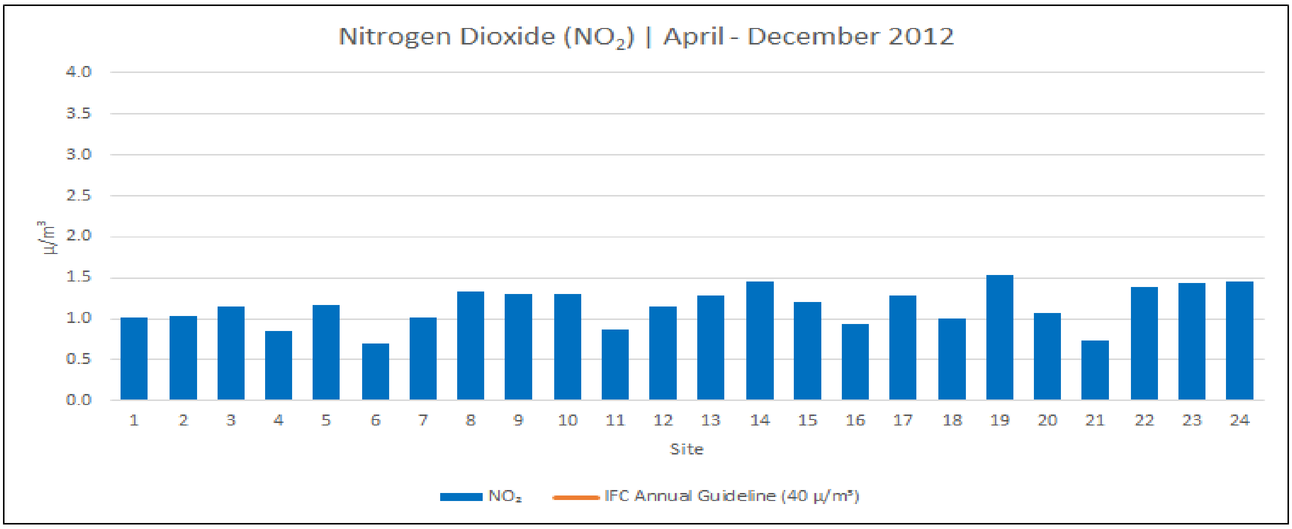


Figure 41: Nitrogen Dioxide (NO_2) (April – December 2012)

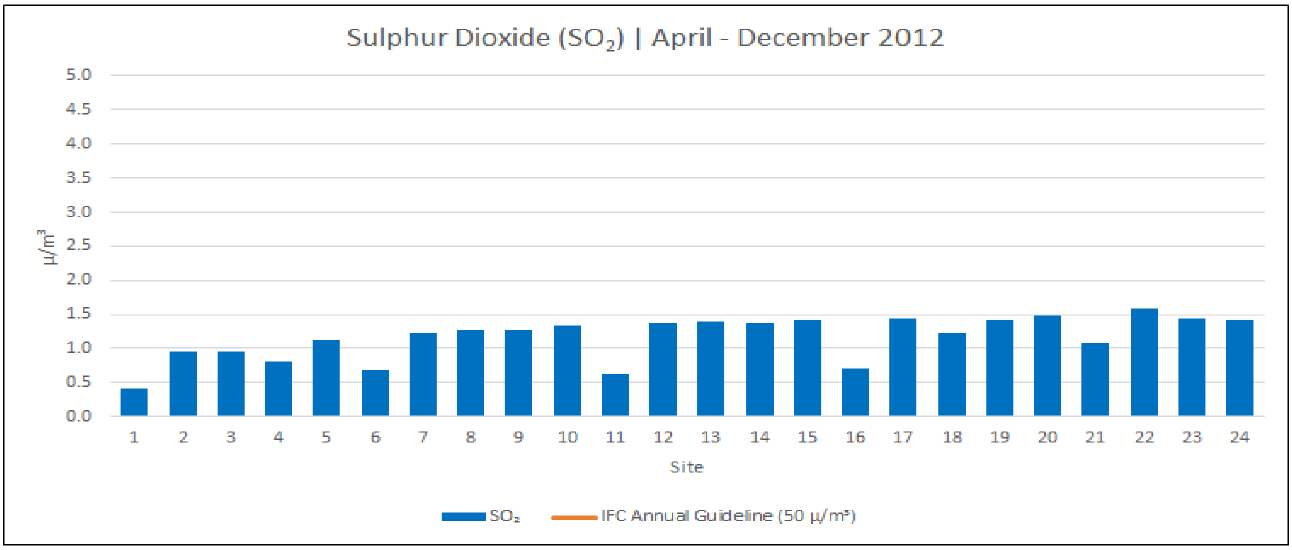


Figure 42: Sulphur Dioxide (SO_2) (April – December 2012)

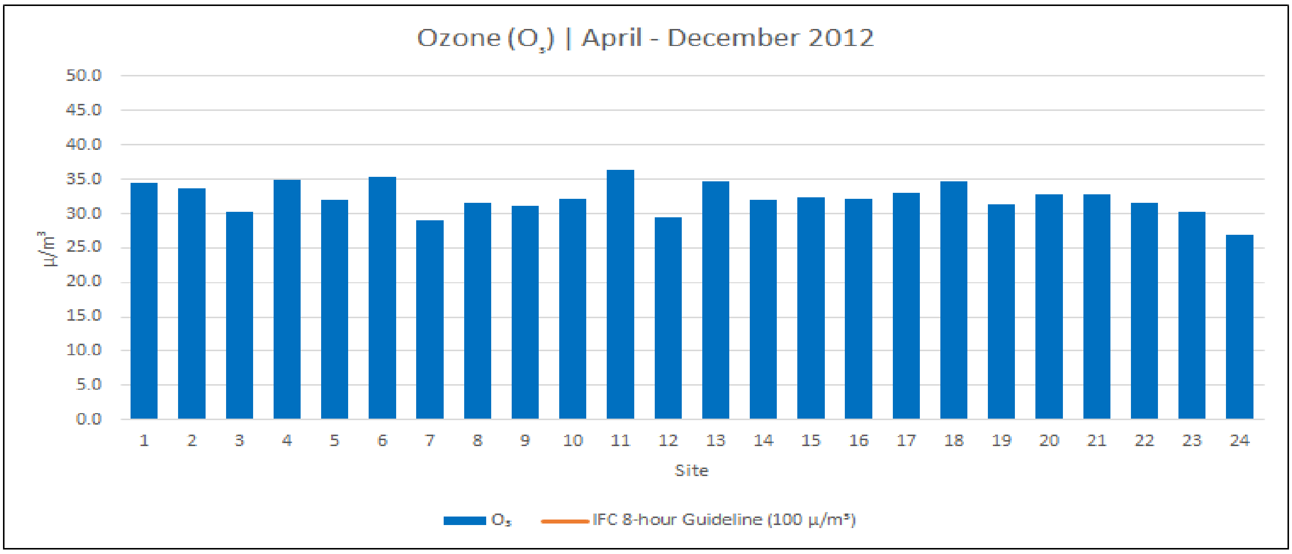


Figure 43: Ozone (O_3) (April – December 2012)

5.6 Noise

A baseline noise monitoring campaign was carried out by African Mining Consultants (AMC) on 7 occasions between November 2010 and September 2012. Ambient noise measurements were conducted at receptors in the study area and at other potentially noise-sensitive locations in the vicinity of the Project. At the time of the survey, the footprint of the mine was not yet finalised, hence some of the survey locations are beyond the study area considered in this assessment, whilst others fall within the outline of mine infrastructure.

The survey results suggest that ambient noise levels in the vicinity of the Project are predominantly above the DRC daytime and night-time fixed limits at all receptors, however, detailed information regarding the types of noise sources contributing to ambient noise levels at each monitoring location was not available. It is not known whether the levels presented refer to daytime or night-time levels. Weather conditions at the time of the background survey were not provided.

The L_{A90} noise parameter is typically considered to be representative of the steady ‘background’ noise level, because it is less affected by short-term noisy events, which may not be representative of prevailing conditions, than the L_{Aeq} ‘ambient’ parameter. The L_{A90} noise level was not available, so Golder has considered the lowest-reported ambient level as representative of baseline conditions.

The measured noise levels for the relevant receptors are provided in Table 26.

Table 26: Baseline Noise Survey Locations and Measured Noise Levels

ID	Monitoring Locations	Grid Reference (UTM)		Measured Noise Level, dB L_{Aeq}
		Easting	Northing	
NS03	DD053 drill site	309612	8804508	39.6
NS04	Londorino Village	311799	8805069	34.0
NS06	Mukanga river upstream of the Kamoa camp	311094	8809106	41.6
NS07	Kamoa River	307279	8812770	40.3
NS08	Kamoa River, downstream of Kamoa Central project area	307537	8816557	41.6
NS12	Mupenda Village 1	314529	8806549	46.1
NS13	Mupenda Village 2	315266	8805756	43.8
NS14	Chamadingi	313439	8811615	41.5
NS15	Katshombesha Village	313326	8812884	36.0
NS16	Kaloko Village	313008	8814439	49.4
NS17	Kalundu Village	308753	8820508	44.2
NS21	Kamoa Mission	307363	8812890	48.1
NS22	Ndjoni	313452	8811623	39.6
NS23	Kaponda Village 1*	307233	8802241	63.1
NS25	Israel Village*	308542	8803967	50.4
NS27	Venance Village*	305610	8811752	44.1
NS28	Kabulo Village*	311089	8809227	47.4
NS30	Mine Accommodation*	308364	8813994	58.3

Note: coordinates for monitoring locations marked with an asterisk were unavailable and have been estimated by Golder.

5.7 Description of water sources and water courses

The Kamoa Copper Project consists of four main drainage catchments (Figure 44):

- Lulua;
- Mukanga;
- Luilu;
- Kalundu; and
- Kamoa.

All the catchments flow west across the DRC, with the exception of the Luilu catchment which flows north. The Mutaka Dam to the east of the proposed Mupenda TSF site has a diversion channel that diverts flow to below the old Kolwezi TSF to prevent flooding of the downstream TSFs in Kolwezi.

5.7.1 Flow characterisation

A summary of streamflow monitoring data collected during the period of July 2010 to February 2015 is provided in Table 27. The reported monitoring period covers four full hydrological years. During the monitoring process there were occasions where gauge plates went missing. In these cases readings were unable to be taken and the information was recorded and theft was logged and the gauge plates re-ordered for replacement.

5.7.2 Water Quality

The surface water monitoring programme consists of a flow and quality network. Water level measurements commenced in 2010 (December) with eight flow monitoring stations for the baseline studies. The monitoring network was subsequently expanded to include fourteen stations at the end of 2013 and again in 2016 to cove or the Kakula area.

Water level readings have been recorded manually bi-weekly. Three stations were equipped with electronic data loggers in 2010, these record water levels every 20 minutes. The surface water quality monitoring network commenced in 2010 (October) with sampling at eleven sites, but has since been increased to fourteen sites sampled on a monthly interval. Two rain gauges were set up in addition to the one that is operating at the Kamoa camp. The rain gauges are located within secure environments which should reduce the chance of theft. Fourteen flow gauging stations were set up on the Lulua, Mukanga, Kalundu, Kamoa, Kalemba, Luilu, Luvumbani, Chamilundu and Kabitungu rivers. A monitoring programme was collected and compiled over three full hydrological years. The coordinates of the river sites selected for the monitoring are shown in Figure 44. Surface water quality monitoring on Kamoa was undertaken by AMC and Golder. AMC data received and analysed is from March 2010 to January 2011 and data analysed from Golder ranges from June 2012 to November 2014.

The AMC data indicates that the water quality in the area is generally very good as it is well below the limits, except for pH. The water quality results for SW01, SW02, SW03, SW04, SW06, SW07, SW08, SW09, SW10 and SW11 shows low values of pH being recorded, which are below the DRC effluent limit of 6 with SW07 being the lowest at 4.79.

Water quality data indicates good water quality with all the parameters well within the limits. The Lulua River has shown a slight increase in manganese in the headwaters but this dissipates downstream along the river. There is also an increase in selenium in the headwaters which decreases downstream but remains above the limits for drinking water. The Mukanga River shows low values of pH and high concentrations of selenium which increase in concentration from the headwater downstream. The Kalundu River has shown low pH values but otherwise is good quality water. The Kamoa River has elevated levels of fluoride, manganese and selenium downstream. The Kalemba River has elevated readings of fluoride in the headwaters which dissipate downstream. It has shown high concentrations of iron, manganese nickel and selenium. Mutaka Dam shows elevated level of manganese, selenium and nickel.

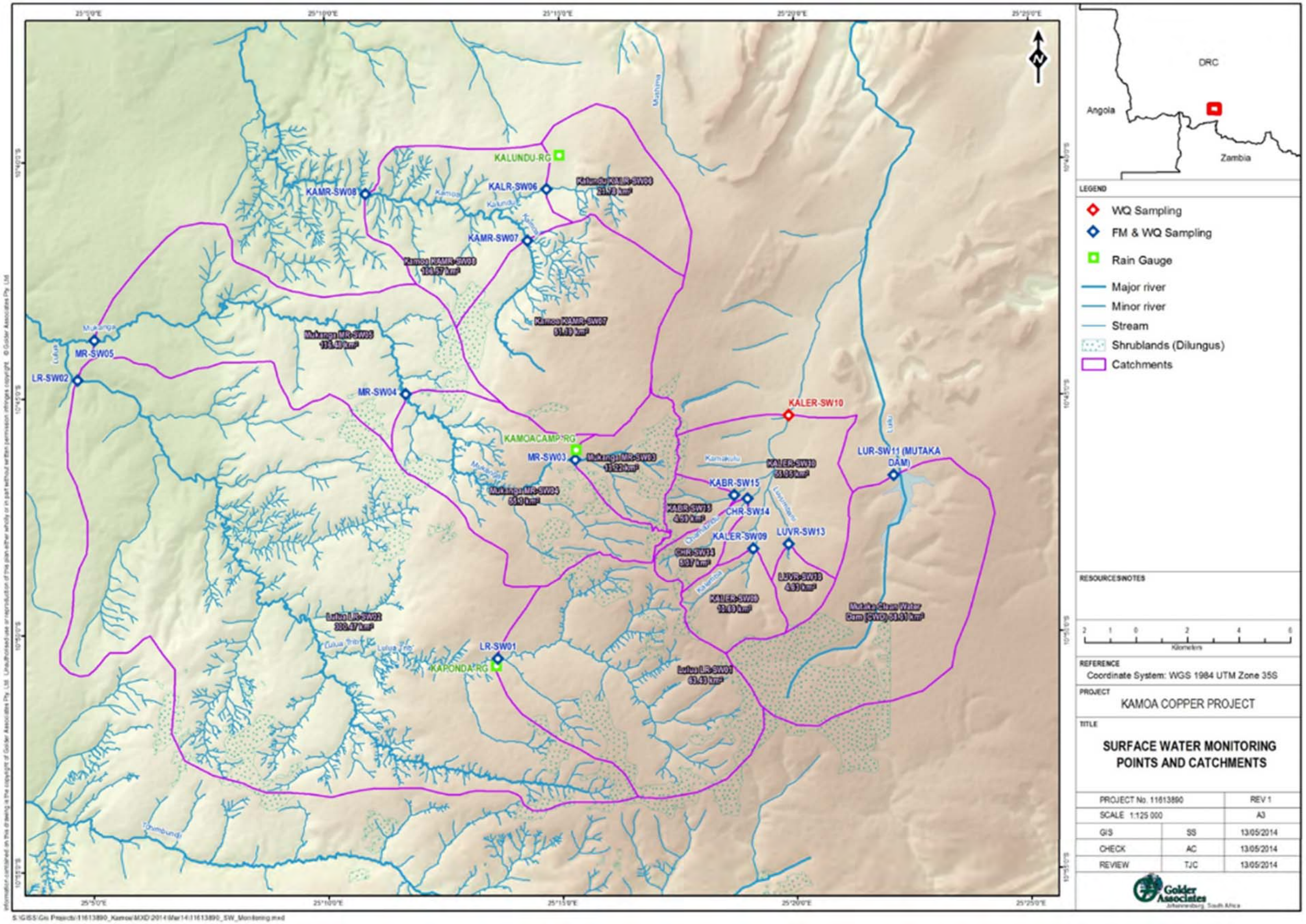


Figure 44: Surface water monitoring locations and catchments

Table 27: Summary of streamflow measured data

River name	Site number	Record period	Data collected	Missing data	Maximum measured (m^3/s)	Minimum measured (m^3/s)	Average measured (m^3/s)
Lulua (LR)	LR-SW01	27 July 2010 to 05 February 2015	113 sets of stage-discharge	5 sets of stage-discharge	1.768	0.006	0.418
Lulua (LR)	LR-SW02	27 July 2010 to 05 February 2015	109 sets of stage-discharge	10 sets of stage-discharge	6.659	0.207	1.563
Mukanga (MR)	MR-SW03	27 July 2010 to 04 February 2015	114 sets of stage-discharge	1 set of stage-discharge	0.744	0.006	0.075
Mukanga (MR)	MR-SW04	28 July 2010 to 04 February 2015	112 sets of stage-discharge	5 sets of stage-discharge	1.654	0.036	0.267
Mukanga (MR)	MR-SW05	27 July 2010 to 04 February 2015	109 sets of stage-discharge	10 sets of stage-discharge	2.506	0.05	0.482
Kalundu (KalR)	KalR-SW06	27 July 2010 to 03 February 2015	113 sets of stage-discharge	No missing data	0.136	0.003	0.040
Kamoa (KamR)	KamR-SW07	26 July 2010 to 03 February 2015	112 sets of stage-discharge	1 set of stage-discharge	1.826	0.095	0.307
Kamoa (KamR)	KamR-SW08	25 July 2010 to 03 February 2015	113 sets of stage-discharge	3 sets of stage-discharge	2.824	0.083	0.566
Kalemba (KaleR)	KaleR-SW09	No data	No data	Missing data			
Luilu (LuR)	LuR-SW11	12 June 2013 to 02 February 2015	41 sets of stage-discharge	No missing data	2.287	0.220	0.532
Luvumbani (LuvR)	LuvR-SW13	01 October 2013 to 02 February 2015	33 sets of stage-discharge	No missing data	0.102	0.025	0.048
Chamilundu (ChR)	ChR-SW14	02 October 2013 to 02 February 2015	33 sets of stage-discharge	No missing data	0.277	0.004	0.046
Kabitungu (KabR)	KabR-SW15	16 April 2014 to 02 February 2015	21 sets of stage-discharge	No missing data	0.104	0.005	0.025

5.8 Hydrogeological study

5.8.1 Data review and update

Inventory of available hydrological information

Data review includes the following:

- Golder (2011) *Hydrogeological Baseline*;
- Golder (2012) *Hydrogeological Baseline*;
- Golder (2013) *Bulk Water Supply - Study of Alternative Source Options Report*1653699-314788-3;
- Golder (2014) PFS *Hydrogeology Study - 2012 - 2013 Field Investigation Completion Report; and*
- Golder (2014) PFS *Hydrogeology Study – Numerical Flow Modelling Report*.

5.8.2 Topographical survey

The surface contours for the study area, depicted in Figure 45, were determined from 90m-grid topographical data obtained from the USGS Shuttle Radar Topography Mission (SRTM). Contours were constructed using the Kriging algorithm of the Surfer software package (Golden Software, 2004).

The concession area forms a gently undulating plateau mostly at an elevation of between 1 450 mamsl and 1 500 mamsl. The plateau slopes gently to the west and northwest to approximately 1 400 mamsl where the West Scarp fault forms a NNE – SSW trending escarpment. The escarpment forms a prominent feature and the elevation falls rapidly some 50 m to about 1 350 mamsl.

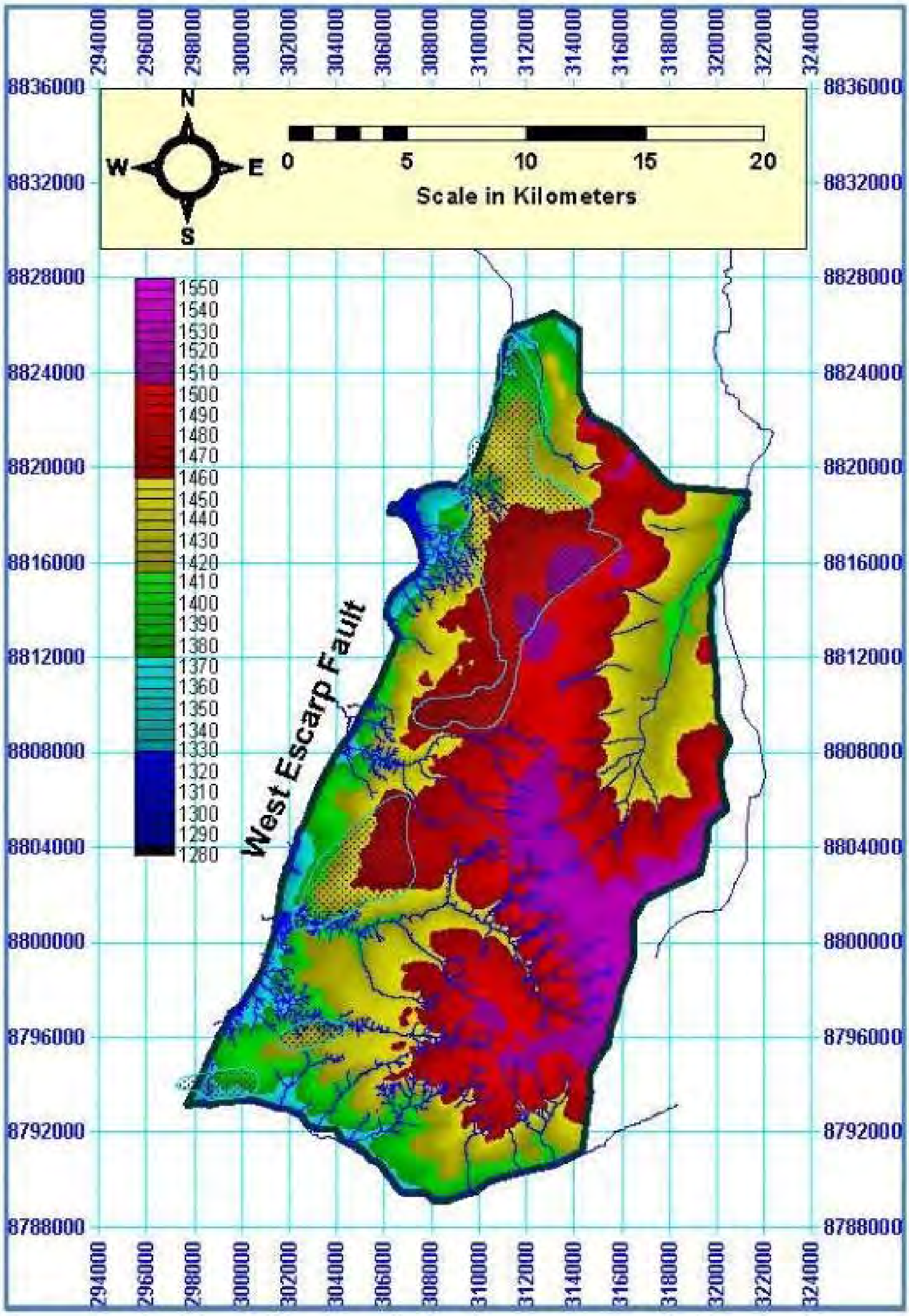


Figure 45: Topographical Contours

5.8.3 Hydrological/Stratigraphical units

The work programme undertaken to define the hydrogeology of the Kamoa Area comprised the following activities:

- Data review - A review of the existing data in conjunction with preliminary mining and infrastructure plans was carried out to identify target areas for the PFS investigation. The expansion of the exploration drilling and the delineation of Kansoko Sud as a priority mining area was an important consideration in guiding this drilling and testing programme;
- Drilling programme - A drilling programme was undertaken to provide quantified hydrogeological data across the study area. A total of 40 boreholes were drilled during this drilling programme. The distribution of the holes drilled is shown in Figure 46, together with the boreholes drilled in 2010, (designated WB); and
- Data evaluation and construction of a conceptual groundwater flow model for the aquifer(s) based on the field information and further the development of a FeFlow 3D finite element hydrogeological model.

The geological and hydrogeological data collected have enabled the groundwater conditions across the project area and the baseline hydrogeological situation to be described. The hydrogeological system of the area is summarised in Table 28.

Table 28: Hydrogeological System

Lithology (Stratigraphical units)	Hydrogeological Designation	Aquifer Occurrence
Kalahari Sand	Sand	Preserved on Dilungus on plateau and in lowland west of escarpment.
Upper Kundulungu	Sandstone and Siltstone	This formation is present in the east of the concession, to the east of the north south trending watershed.
Upper Diamictite	U-SDT	Ubiquitous away from sandstone dome. Weathered and deeply fractured. Intercalations of siltstone and sandstone.
Pyritic Siltstone	KPS	Where fractured significant groundwater intersections, otherwise semi impermeable.
Basal Diamictite – Mineralised Zone	B-SDT	Minor water strikes to dry.
Contact zone with Roan Sandstone	B-SDT/B-SST	Contact zone characterised by a narrow zone of minor water strikes.
Roan Sandstone – deep regional aquifer	B-SST	Outcropping on Plateau – Kamoa and Makalu Domes, sub-outcropping on the Kalula and Kakula Domes in the south. Characterised by deep water levels >120 mbgl and well developed permeability, forming the deep lower footwall aquifer of the area.

The area is characterised by a widespread, well developed, secondary anisotropic aquifer within the hanging wall Upper Diamictite. This aquifer is underlain by the Pyritic Siltstone and Lower Diamictite. These two lithologies are characterised by low permeability and appear to act as an aquitard separating the main aquifer from the deep footwall aquifer present in the Roan Sandstone. These sandstones outcrop forming the Kamoa and Makalu domes, and sub-outcrop forming the Kalula and Kakula Domes.

The hydrogeological setting can be summarised as:

- The Upper Diamictite comprises the main water bearing horizon (main aquifer) of the area. This aquifer is well developed and with saturated thickness in excess of 200 m in places;
- The weathering thickness of the Upper Diamictite varies within a wide range from 20 to 60 m or more, and a minor aquifer is associated with the weathered zone;

- Groundwater occurrence within the main aquifer is controlled by the presence of fracture zones within the Upper Diamictite rock mass. Multiple fracture zones are usually present below ±50 m. Cumulative blow yields obtained from boreholes vary from 0.5 l/s to 10 l/s, with the higher yields generally associated with the thicker Upper Diamictite. Transmissivity values as determined from testing undertaken vary from 3 to 250 m^2/d with the average between 25 to 50 m^2/d. These values confirm that the permeability of the Upper Diamictite is relatively well developed;
- Water levels are generally shallow throughout the concession, between 10 to 20 mbgl, deepening to the west and NW towards the West Scarp Fault zone;
- The groundwater flow is towards the west and NW (Figure 50, Figure 51 and Figure 52). The groundwater flow follows the local topography and the flow is to the south in the south of the concession in the Kakula area (Figure 47);
- It appears that the West Scarp Fault acts as a discharge zone, capturing groundwater flow to the west;
- The water level in the sandstone of the Kamoa Dome anticline is below that of the Upper Diamictite at approximately 130mbgl. The mineralised zone therefore appears to act as a hydraulic barrier to groundwater flow between the Upper Diamictite and the footwall sandstone;
- The water level monitoring confirms that the aquifers are recharged seasonally, with a rise in water level of 20 m or more following the onset of the rains. Figure 48 and Figure 49 below shows the water level rise has a lag of between 2 to 3 months; and
- The Kamoa and Makalu Domes acts as a barrier to groundwater flow, and force groundwater flow in the Upper Diamictite aquifer to move around the domes to the south.

The hydraulic properties determined for the Upper Diamictite, Basal Diamictite and KPS are presented in Table 29, Table 30 and Table 31.

Table 29: Hydraulic Characteristics for the Upper Diamictite

	Area	WL (mbgl)	T (m^2/day)	CDT Yield (l/s)	CDT Durat. (Hrs)	Maximum D/D (m)	Residual D/D (m)	Residual D/D (%)
WB13	Plateau near Domes	30.04	33	1.9	24	4.75	0.46	10
BL5	Plateau near Domes	111.93	18	5.0	48	17.93	5	28
BL6	Plateau near Domes	33.22	3	3.1	24	38.9	0.90	2
BL11	Decline no. 1	57.75	70	8.0	48	10.82	0.57	5
GR1	Plateau near Domes	151.47	360	7.6	48	2.24	0.36	16
GR2	West Escarpment	19.14	9	6.7	52	45.90	1.02	2
GR7	West Escarpment	29.23	50	6.3	48	14.87	0.02	0
Scarp4	West Escarpment	21.16	4.5	3.0	21.5	42.01	0.46	1

Table 30: Hydraulic Characteristics for the Basal Diamictite

Hole ID	Area	WL (mbgl)	T (m^2/day)	CDT Yield (l/s)	CDT Durat. (Hrs)	Max. D/D (m)	Residual D/D (m)	Residual D/D (%)
BL3A	Near Dome Makalu	70.77	0.6	0.16	1	27.25	0.50	2
GR3A	Escarpment	47.30	2.5	0.6	72	9.08	0	0

Table 31: Hydraulic Parameters KPS

Hole ID	Area	WL (mbgl)	T (m^2/day)	CDT Yield (l/s)	CDT Durat. (Hrs)	Max. D/D (m)	Residual D/D (m)	Residual D/D (%)
GR4	Plateau near Escarpment	84.73	130	8.1	48	15.29	0	0

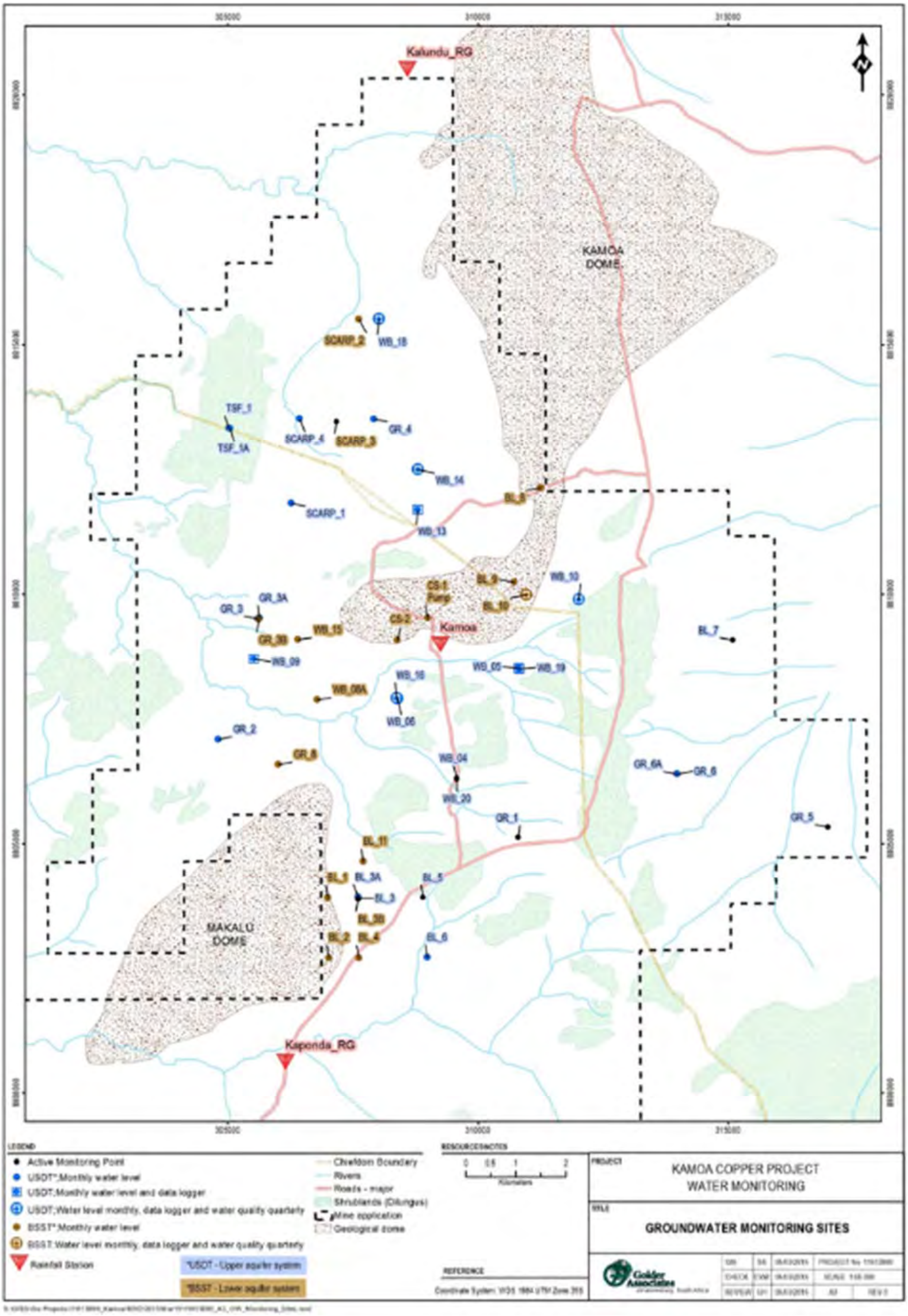


Figure 46: Kamoa Hydrogeological Boreholes Drilled and tested (2010 to 2013)

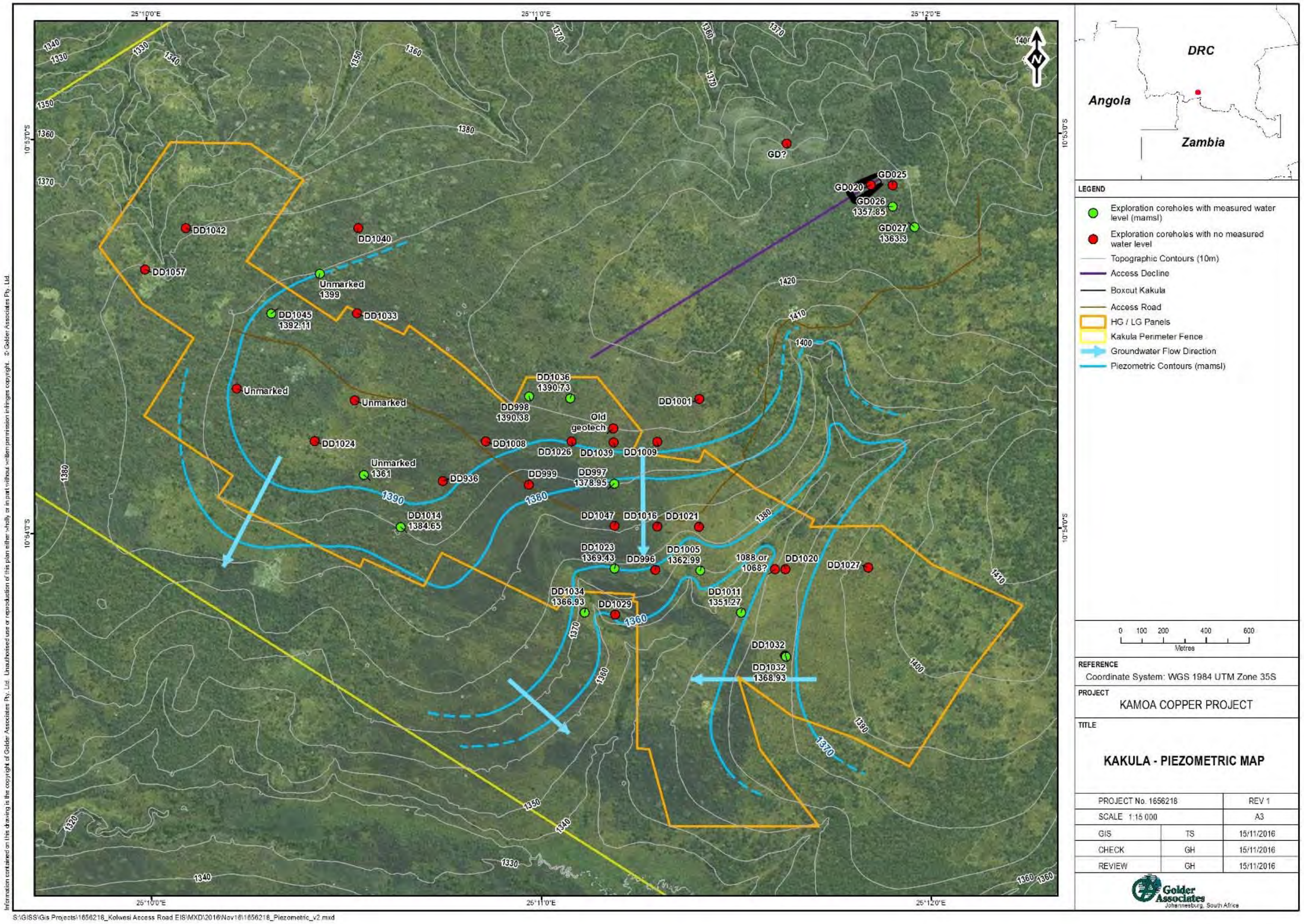


Figure 47: Piezometric map of the Kakula Area

5.8.4 Groundwater levels

The monthly measurements are taken manually from the borehole collar down to the water table and reported as metres below ground level (mbgl) and as metres above mean sea level (mamsl) as indicated in Table 32 .

The groundwater monitoring data have been compared to the local rainfall data to illustrate the relationship between water levels responses driven by rainfall depths.

The December piezometric levels are listed in Table 32 and illustrate the water table difference between different aquifer systems in the Kamoa area. The piezometric levels in the Kamoa study area reached their highest level during the months of March-April due to the local groundwater recharge mechanism driven by high summer rainfall from November until April. The average differences between the dry (lowest/deepest) and wet (highest/shallowest) seasonal water levels are indicated in Table 32.

The seasonal water level fluctuations are the highest in the Upper Diamictite (USDT) aquifer system, which occurs just below the younger Kalahari deposits and vary between 52 m and 4 m (mean = 10 m). This variation in the Basal Sandstone aquifer system (BSST) is ~5.7 m, and indicates a significant difference in the storativity of the two systems given direct recharge input.

Table 32: Comments on 2010-2014 seasonal water level trends in different aquifer systems.

Borehole ID No. –Depth (m)	Borehole collar elevation (mamsl)	December 2014 water level depth (mbgl)	Water level elevation (mamsl)	General comments of water level trends
Upper Diamictite main aquifer (USDT)				
BL 3–200	1474.1	Na	Na	Large (~40 m) oscillation from dry to wet seasons.
BL 3A–165	1474.4	64.83	1409.6	Significant (~52 m) oscillation from dry to wet seasons.
BL 6–253	1453.0	17.70	1435.3	Moderate (~13 m) oscillation from dry to wet seasons.
GR 2–250	1380.7	16.61	1364.1	Moderate (~18 m) oscillation from dry to wet seasons.
GR 3–252	1389.9	46.21	1343.7	Moderate (~10 m) oscillation from dry to wet seasons.
GR 3A–193	1391.3	47.87	1343.4	Moderate (~17 m) oscillation from dry to wet seasons.
GR 4–230	1444.8	98.91	1345.9	Moderate (~19 m) oscillation from dry to wet seasons.
GR 6A–245	1487.8	65.15	1422.7	Large (~32 m) oscillation from dry to wet seasons.
SCARP 1–253	1394.3	46.72	1347.6	Large (~26 m) oscillation from dry to wet seasons.
SCARP 4–233	1353.0	20.44	1332.6	Small (<2 m) oscillation from dry to wet seasons.
WB05–301	1474.0	15.29	1458.7	Small (~7 m) oscillation from dry to wet seasons.
WB06–228	1455.6		1455.6	Receding (-21 m) oscillation from 2010 to 2014.
WB10–168	1488.2	14.58	1473.6	Receding water level trend (poor dataset).
WB13–51	1454.4	33.14	1421.3	Large (~38 m) oscillating from dry to wet seasons.

Borehole ID No. –Depth (m)	Borehole collar elevation (mamsl)	December 2014 water level depth (mbgl)	Water level elevation (mamsl)	General comments of water level trends
WB14–133	1453.6	30.88	1422.7	Large (~34 m) oscillating from dry to wet seasons.
WB16/–61	1455.4	51.40	1404.0	Large (46 m) oscillation from dry to wet seasons.
WB18–86	1376.4	47.62	1328.8	Receding (~4.5 m) fluctuating water level trend.
WB19–86	1474.4	5.21	1469.2	Small (~4 m) fluctuation water level behaviour.
Deep Sandstone aquifer				
BL 1–231	1476.6	141.30	1335.3	Small (<5 m) oscillation from dry to wet seasons.
BL 2–226	1461.8	117.75	1344.1	Small (<5 m) oscillation from dry to wet seasons.
BL 4–160	1463.3	123.92	1339.4	Small (~9 m) fluctuation water level behaviour.
BL 8–204	1484.3	116.93	1367.4	Small (~5 m) oscillation from dry to wet seasons.
BL 9–246	1485.6	147.65	1338.0	Small (~3 m) oscillation from dry to wet seasons.
CS 2–185	1467.4	116.06	1351.3	Small (~9 m) oscillation from dry to wet seasons.
GR 3B–217	1390.9	48.06	1342.8	Moderate (~17 m) oscillation from dry to wet seasons.
GR 8–249	1439.1	103.11	1336.0	Small (~7 m) oscillation from dry to wet seasons.
SCARP 2–250	1322.3	42.56	1279.7	Small (<2 m) fluctuating water level trend.
WB08A/–121	1443.1	93.00	1350.1	Significant (~54 m) oscillation from dry to wet seasons.
WB15–149	1430.1	86.66	1343.4	Large (~24 m) peaks between fry and wet seasons.
Other boreholes (Upper Diamictite and Basal Sandstone aquifer systems probably linked through borehole)				
BL 3B/–193	1474.3	92.98	1381.3	Large (~27 m) oscillation from dry to wet seasons.
BL 7/–256	1465.3	13.72	1451.6	Moderate (~10 m) oscillation from dry to wet seasons.
BL 5/–268	1470.0	106.43	1363.6	Moderate (~10 m) oscillation from dry to wet seasons.
GR 1/–260	1495.8	150.71	1345.1	Small (~4 m) fluctuating water level trend.
WB04/–270	1473.2	79.68	1393.5	Significant (~76 m) rising water level from 2010.
WB09/–257	1405.3	61.48	1343.8	Large (~30 m) oscillation from dry to wet seasons.

Borehole ID No. –Depth (m)		Borehole collar elevation (mamsl)	December 2014 water level depth (mbgl)	Water level elevation (mamsl)	General comments of water level trends
WB20/–46		1472.7	14.14	1458.6	Receding water level – poor dataset.
SCARP 3/–245		1407.8	65.13	1342.7	Large (~30 m) oscillation from dry to wet seasons.
Tailings storage facilities (northwest of Kamoa Camp)					
TSF 1/–197		1344.5	13.72	1330.8	USDT, receding (~9 m) water level trend, post 04/13.
TSF 1A/–16		1344.7	2.41	1342.3	Kalahari, receding (~2 m) water level, post 04/13.
Mupenda tailings storage facility (southeast of Kamoa camp)					
GR 5/–121		1468.4	9.07	1459.3	USDT, small (~9 m) oscillation from dry to wet seasons.
GR 6/–136		1487.7	43.41	1444.3	Large (~28 m) oscillation from dry to wet seasons.

5.8.5 Groundwater Flow Directions and Gradients

The groundwater levels were used to construct a series of groundwater piezometric surface presented as piezometric contours. Due to the two different aquifer systems, piezometric contours for the Upper Diamictite Main and the Basal Sandstone aquifers are illustrated separately. Two periods based on water level responses, i.e. highest elevations around March-April and lowest elevations around December, have been observed.

5.8.5.1 Upper Diamictite Main Aquifer

The groundwater levels observed during April 2014 are corrected for elevation and used to construct the piezometric elevations of the groundwater table of the Kamoa study area illustrated in Figure 50.

The general groundwater flow direction is from the eastern Kamoa study area towards the West Escarp Fault. The groundwater elevation at the fault is ~1 333 mamsl and gradually rises to drops to ~1 430 mamsl at the BLY Camp site (i.e. the central Kamoa study area). The West Escarp Fault Zone seems to have a significant effect on the groundwater flow regime in the study area and is probably responsible for the dynamic annual water level fluctuations observed in the water level data (see Figure 48 and Figure 49 above).

The groundwater levels observed during December 2014 are illustrated in Figure 51. The December-month water levels in the study area are the lowest levels probably due to discharges (significant dry season recession period from April to December each year) along the fault zone and the three-month recharge delay observed on the water level time series dataset from when the rainy season starts in late September—early October. The overall groundwater flow pattern is not particularly different for the end-wet season (i.e. April) and clearly confirms the annual drainage towards the West Escarp Fault Zone.

The groundwater levels observed for the Kakula area in October 2016 are depicted in Figure 47. This illustrates that groundwater flow in this area closely follows the topography, varying in depth from >20 m bgl to artesian on the edges of steep sided valleys. Groundwater flow is generally in a southerly direction in the Kakula mining area.

5.8.5.2 Lower Basal Sandstone Aquifer

The groundwater piezometric surface for April 2014 is illustrated in Figure 52 and reiterates the general groundwater flow towards the West Escarp Fault Zone A few boreholes have either deeper/higher water table elevations – especially in the BSST outcrop areas.

The reason might be local flow differences in the aquifer systems; although the piezometric surface at monitor site BL9 (southern outcrop area of the Kamoa Dome) indicates a -13 m depression into local the piezometric surface of ~1 350 mamsl. The time series dataset does not report any abstraction response and therefore represent rest level conditions - the reason for this phenomenon is unclear.

The groundwater levels observed during December 2014 do not differ much from the April 2014 pattern as well as the general annual north-westerly flow direction (i.e. towards the West Escarp Fault Zone as mentioned above. Significant differences between the April 2014 high elevations and December 2014 lower elevation occur at monitoring sites GR3B and WB15 towards the west, i.e. 16 and 23 m respectively. The local piezometric depression at BL9 seems to be consistently present all year.

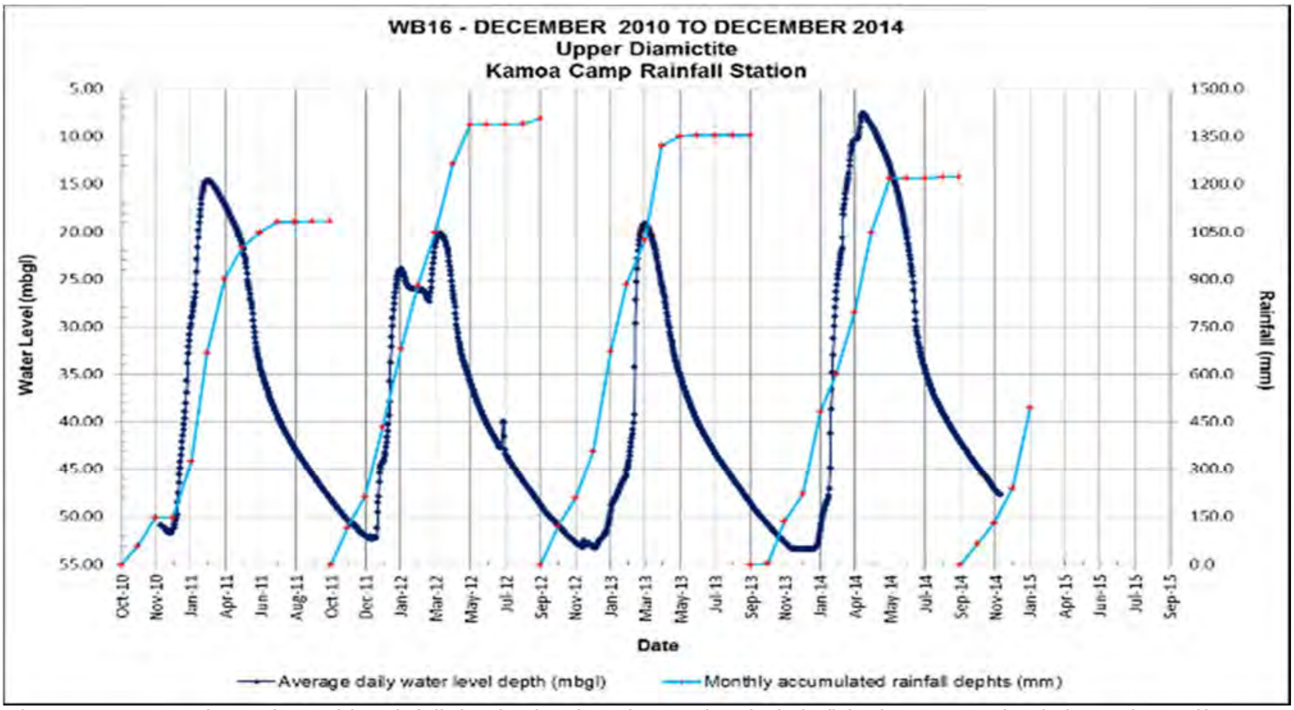


Figure 48: Comparison of monthly rainfall depths (mm) and water levels (mbgl) in the Upper Diamictite main aquifer as observed at monitor site WB16

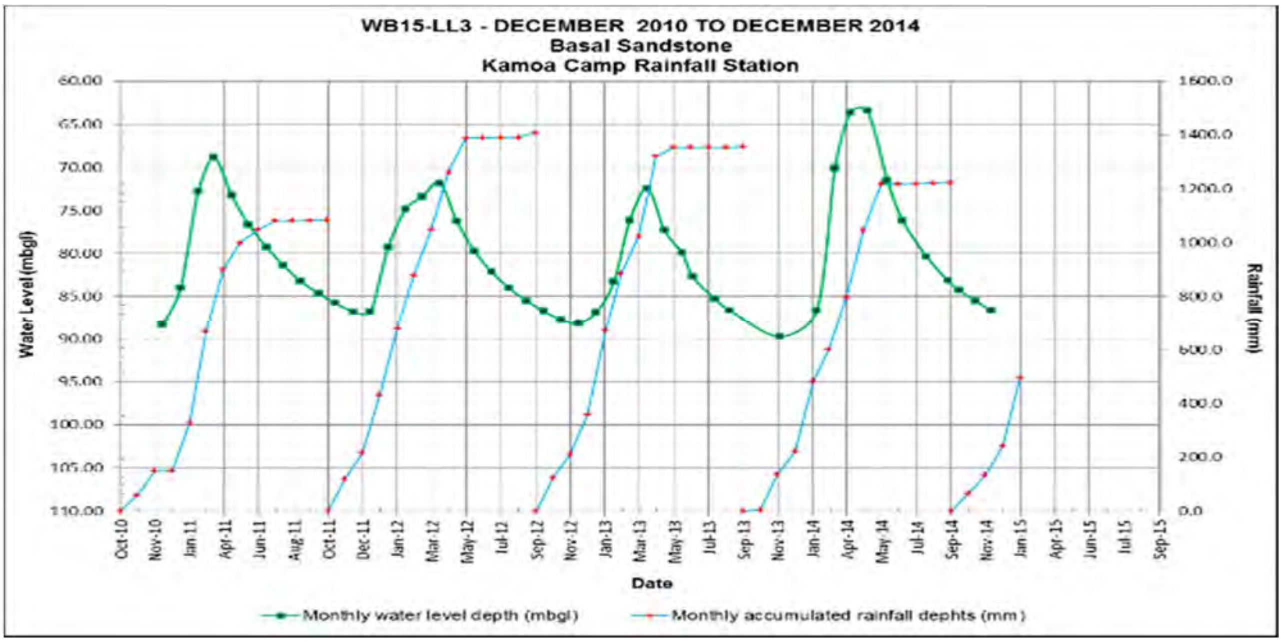


Figure 49: Comparison of monthly rainfall and water levels in the Basal Sandstone aquifer as observed at monitor site WB15 (Only monthly hand measurements)

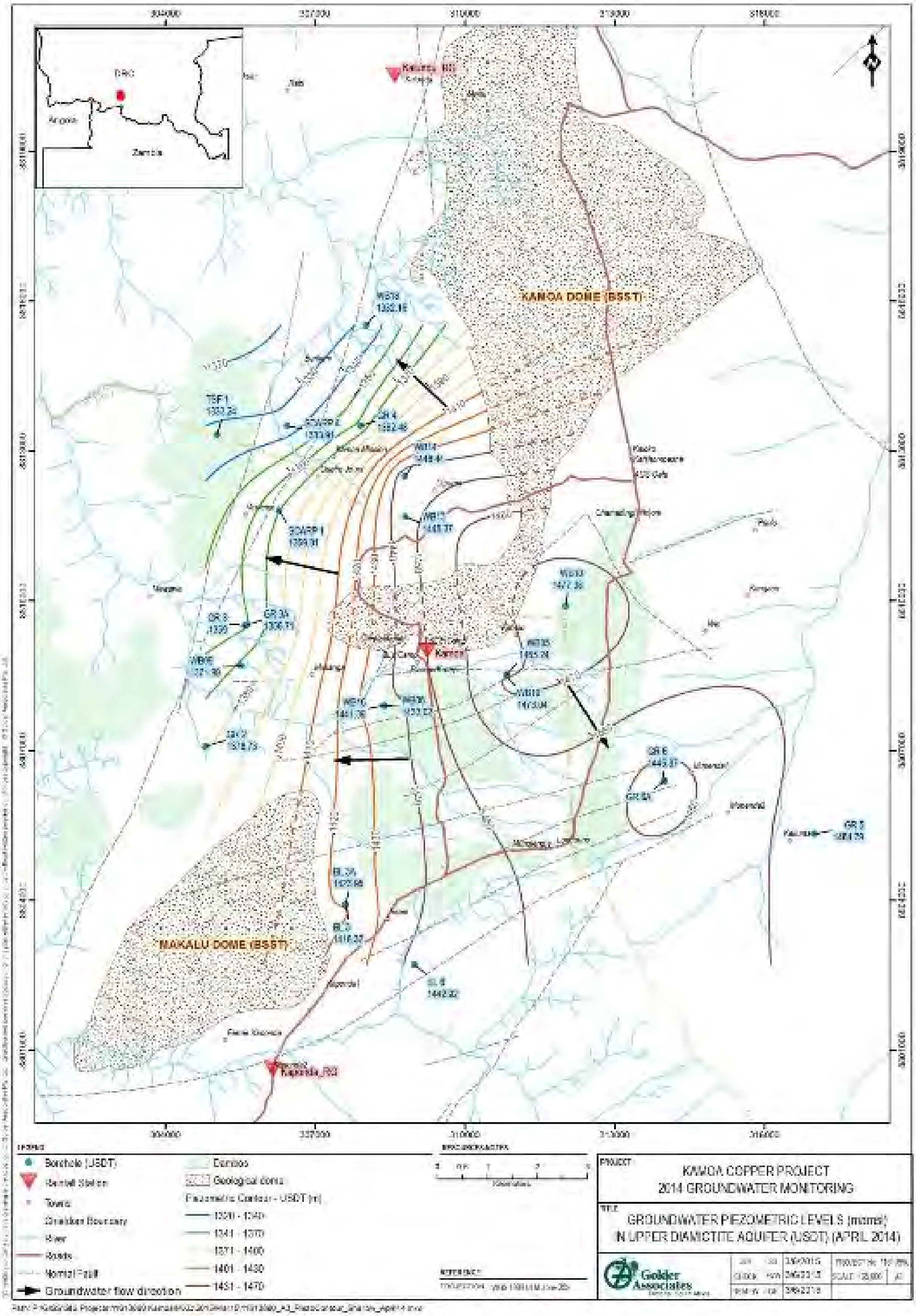


Figure 50: Piezometric elevations for the groundwater levels in the Upper Diamictite (USDT) observed in April 2014

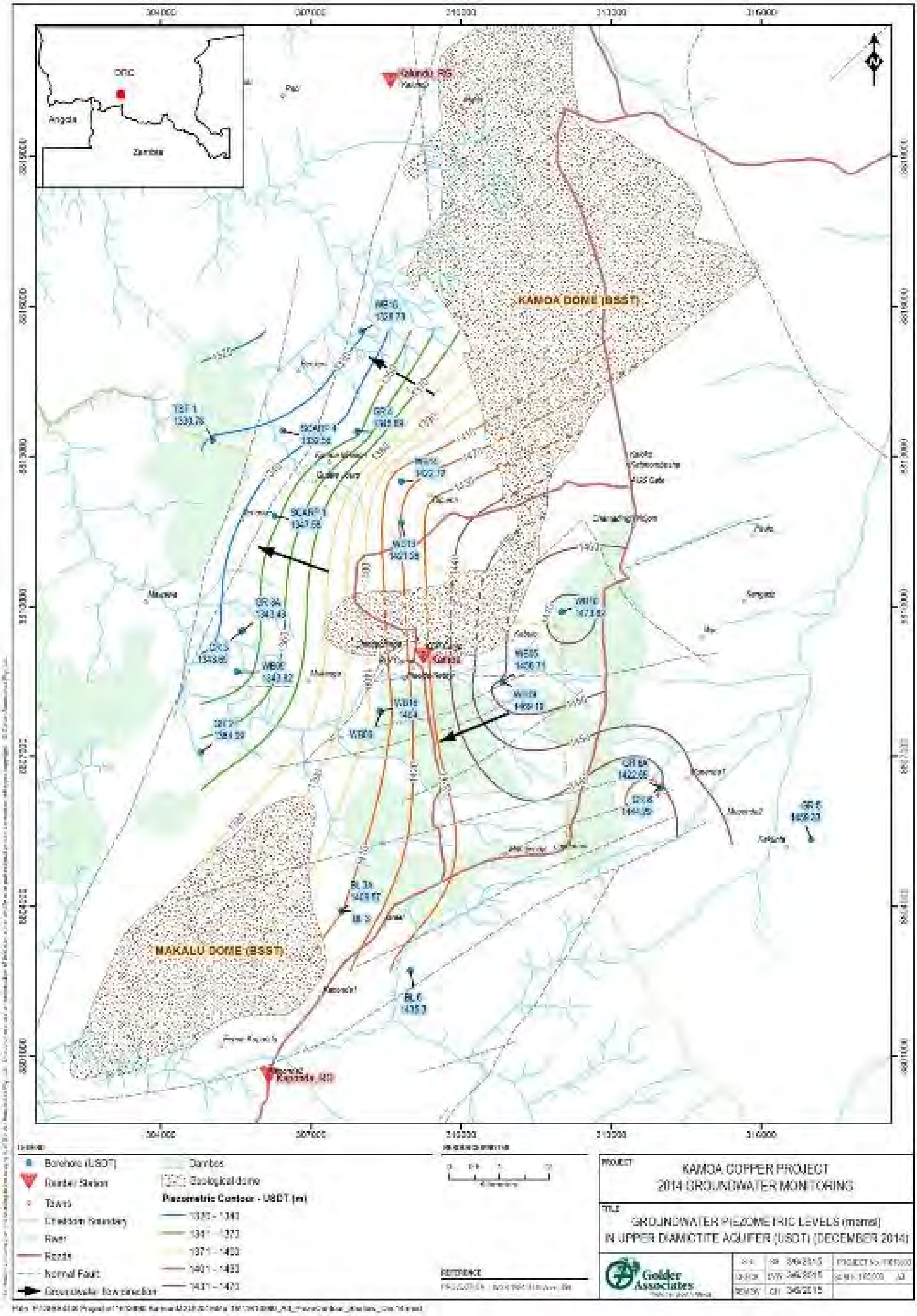


Figure 51: Piezometric contours for water levels in the Upper Diamictite (USDT) for December 2014

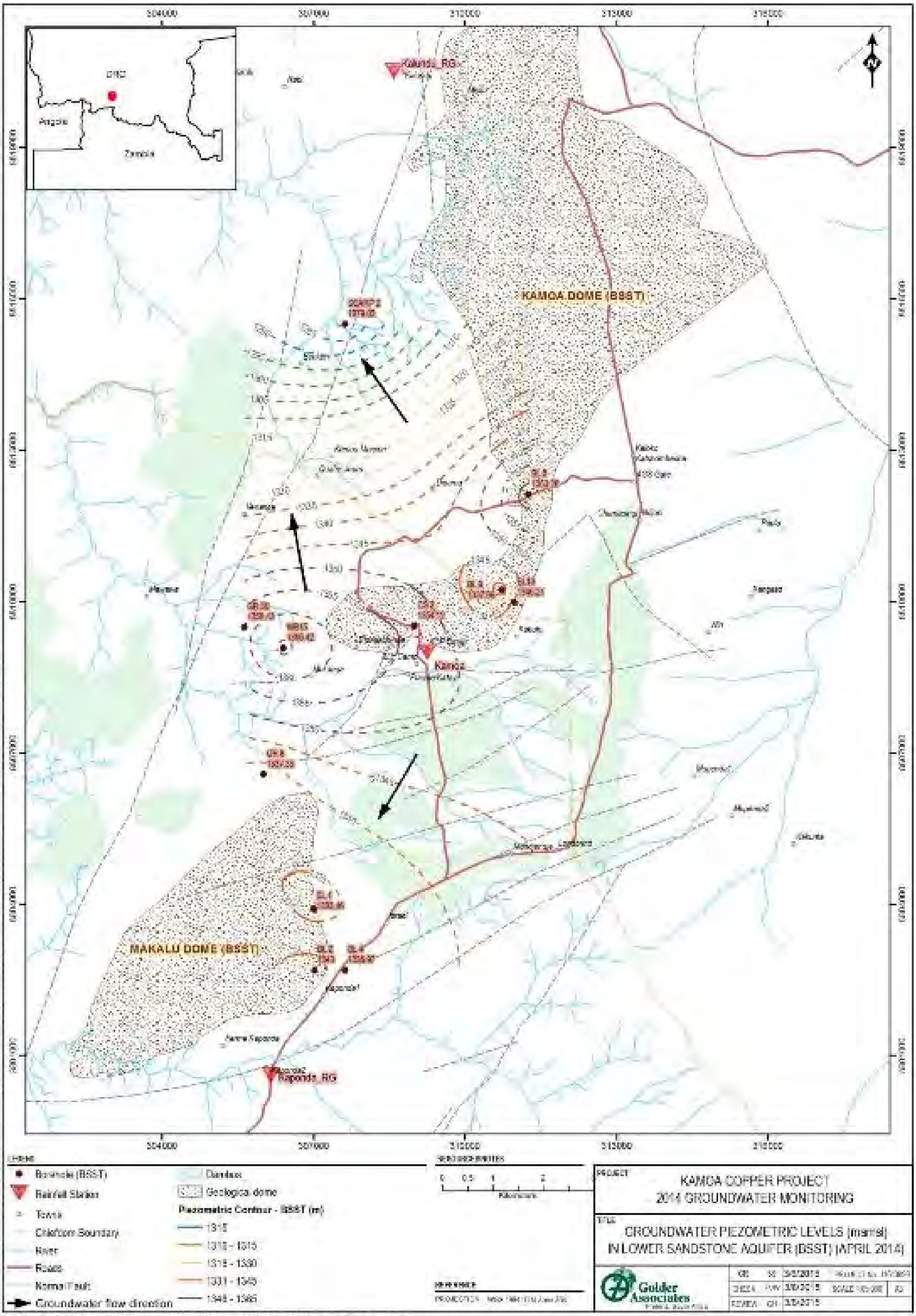


Figure 52: Piezometric elevations for the groundwater levels in the Basal Sandstone Aquifer (BSST) observed in April 2014

5.8.6 Groundwater Quality

Quarterly groundwater samples were collected from 13 monitoring sites (the WB- boreholes) for the period October 2010 to December 2014 on a quarterly interval. Sampling on a more recent group of boreholes started in April 2013 and linked with the former group up to December 2014. The samples were sent to UIS Laboratories in Centurion, South Africa – A SANAS accredited testing laboratory for analyses of the macro and trace determinants. The determinants' analysed are listed in Table 33.

Table 33: Determinants for Groundwater Sample Analysis

Determinant	Determinant
pH	Calcium
Electrical Conductivity (@ 25°C)	Magnesium
Calculated TDS from EC	Silica
Total Dissolved Solids (TDS)	Iron (Fe)
Calculated Hardness (Ca+Mg hardness) $CaCO_3$	Manganese (Mn)
Calculated TDS by Summation	Potassium
Suspended Solids	Sodium
P and M Total Alkalinity (x 1.219 = Bicarbonate HCO_3)	Fluoride
	Nitrate
Ion Balance Error	Chloride
	Phosphates
Trace elements in liquids by ICP - MS	Nitrite
	Sulphide

Overall the area is characterised by pristine quality groundwater.

Discussion of Water Quality

Physical Parameters

The pH range for the Upper Diamictite main aquifer system varies between 5.64 and 7.46 (10th and 90th percentiles), with the median at 6.42. This confirms the groundwater is neutral to slightly acidic, which is consistent with the low TDS (16.3 mg/l median) and EC (2.50 mS/m median).

The pH range for the Basal Sandstone aquifer system varies from 5.70 to 7.48 (10th and 90th percentiles), with the median at 6.31; practically the same as the USDT aquifer. The TDS ranges between 6.95 mg/l (10th percentile) and 82.8 mg/l (90th percentile) with the mean at 19.5 mg/l.

The total dissolved solids (TDS) values for both aquifer systems are classified as low and represent a good groundwater type characteristic of recently recharged rainwater. The water quality results from the total sample period (October 2010 to December 2014) indicate that none of the macro determinant concentrations exceed tDRC water quality standards. The concentrations of health related elements such as Nitrate (NO_3-N) and Fluoride (F) are just above or below detection level, i.e. 0.3 mg/l as NO_3 and 0.1 mgl/ F.

The TDS pattern between the two aquifer systems do not differ significantly except for a few monitoring sites in the Upper Diamictite main aquifer System which can be regarded as local anomalies. In general, the lowest TDS values (i.e. best water quality) occurs right in the central part of the Kamoa study area (<10.0mg/l) and increases towards the northwest (i.e. monitor sites TSF1, SCARP 4 and GR4).

A large TDS anomaly in this regard is noted at monitoring site GR3A (USDT Aquifer System) where the TDS value is ~520 mg/l, compared to <10.0 mg/l elsewhere. The hydrochemical analyses for this site indicate that this relatively high TDS is not an occasional event, but is consistent over time (i.e. since 2013). It is specifically the pH values (>10.0), Ca (59 mg/l), K (~6.5 mg/l) and HCO_3 (~415 mg/l) that are markedly higher than the norm for the KCP study area. The reason for this anomaly is not known and requires further investigation.

Macro Determinates and Trace Metals (Fe, Mn and Zn)

In general, the following remarks relating to the general groundwater quality are made:

- Concentration values for Calcium (Ca), Chloride (Cl), Fluoride (F), Magnesium (Mg), Sodium (Na), Potassium (K), Nitrate (NO_3 as N) and Sulphate (SO_4) are well within the standards of the WHO (2011);
- Concentrations for F, PO_4 and NO_2 and NO_3 were below detection levels of 0.1, 0.8, 0.2 and 0.3 mg/l respectively; and
- For the trace metal concentrations, iron (Fe) and manganese (Mn) concentrations are above the WHO limit of 0.3 mg/l and 0.1 mg/l respectively in several boreholes, but GR3 (Fe: ~7 mg/l) and BL10 (Mn: 0.95 mg/l) have the highest concentration levels. Concentration levels for zinc (Zn) are on average 0.82mg/l and are below the WHO limit of 4.0mg/l.

Micro Determinants

All micro determinants were determined using an ICP-MS scan. None of the elements, except iron and manganese concentrations exceed the WHO (2011) standards as mentioned above. The reason for these elevated concentrations could be linked to isolated mineralised zones in the rock formation.

Groundwater Quality Trends

The groundwater quality-monitoring programme since October 2010 covers thirteen (13) boreholes and 35 since April 2013. Sampling is conducted on a quarterly interval and allows the data to be presented as a time series of water quality – in this case using the macro constituent's concentration levels.

The objective of the time series dataset is to identify any long-term trends of particular importance in the dataset and to identify any specific element that may indicate a time-related change in the water quality such as the development of a pollution plume in the KCP site area.

Time series water quality trends for representative boreholes in the two main aquifers are portrayed in Figure 53 and Figure 54 between October 2010 and December 2014 for the Upper Diamictite main aquifer and Basal Sandstone Aquifer Systems respectively.

An overall observation is that the macro hydrochemistry signature of the 2010 – 2014 interval indicates a slight improvement (i.e. decreasing of concentration levels) in the groundwater quality in the Upper Diamictite Main Aquifer System

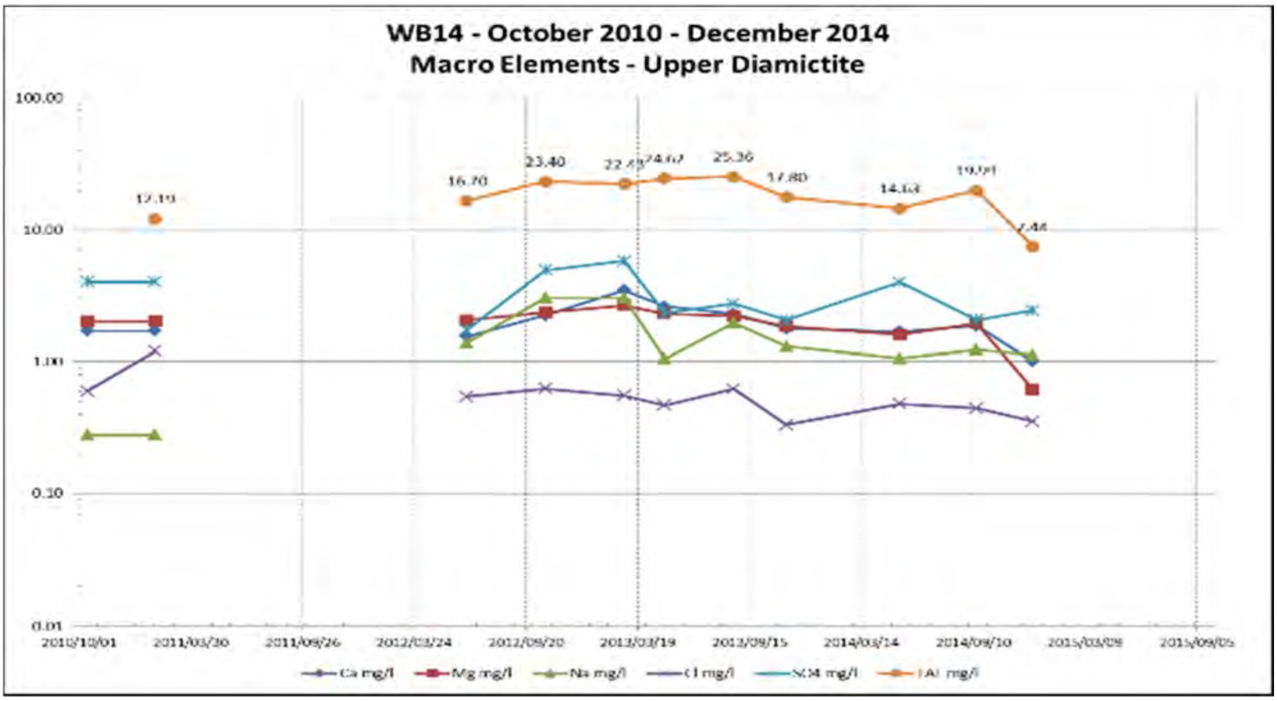


Figure 53: Time Series plot of groundwater quality at monitor site WB14, USDT Aquifer System

A seasonal fluctuation is noted in the water quality signature since the water-sampling programme is conducted on a quarterly interval and is probably the result of the recurring significant recharge events taking place during January – February interval as observed in the water table graphs (Figure 48).

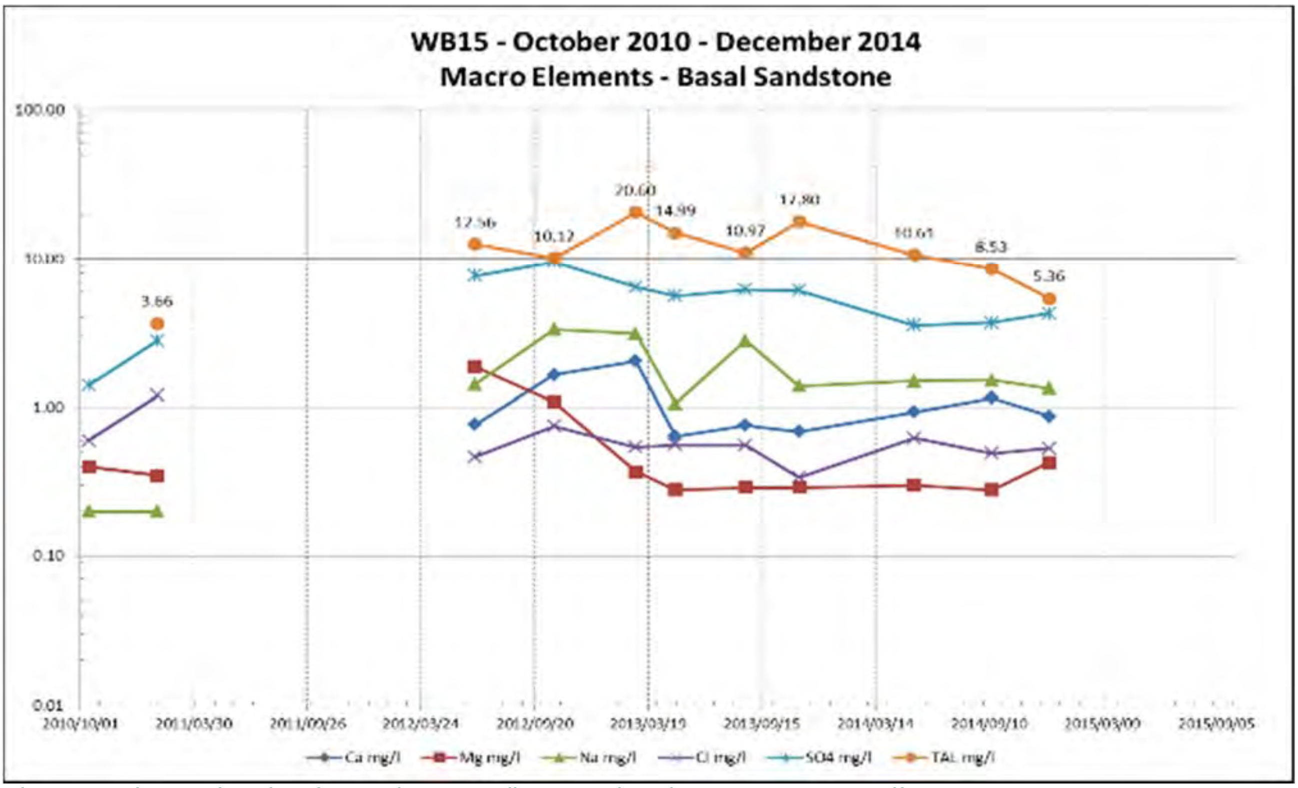


Figure 54: Time Series plot of groundwater quality at monitor site WB15, BSST Aquifer System.

The time series dataset indicates that bicarbonate (HCO_3) - sulphate (SO_4) and a combination of calcium (Ca) and sodium (Na) represents the major ionic concentration in the groundwater – these concentration values are low and fall within the recommended drinking water quality criteria of the WHO. This process instigates a blending of the resident aquifer water with annual recurring rainwater recharge (a dominant Ca/Mg-HCO_3 water type).

5.9 Modelling study

5.9.1 Type of modelling work carried out

The programme undertaken by Golder has comprised the following:

- Evaluation of available hydrogeological data;
- Construction of the conceptual groundwater flow model for the aquifer(s) based on the field information;
- Selection of the FeFlow 3D finite element modelling code;
- Construction and calibration of the numerical groundwater flow model;
- Simulation of inflows to the underground mine (UGM), first underground mine access decline and raw water demand from the Basal Sandstone over the Life of Mine (LOM); and
- Determination of impacts of the mining operation on the groundwater regime and possible decant post-mine closure.

5.9.2 Introduction

The hydrogeological modelling investigation assesses the magnitude of the groundwater resources present within the concession and provides information for the impact assessment, both in terms of the impact the groundwater regime could have on the proposed mining operations and the potential impacts on the groundwater resources resulting from the mining operations. The objectives for the hydrogeological modelling are summarised as follows:

- Construct a hydrogeological flow model based on the conceptual understanding of the geology and hydrogeology of the study area;
- Calibrate the flow model constructed based on the hydrogeological information collected, (Model Calibration to be conducted for Pre-Mining Flow Regime as well as for Temporal Flow Regimes where the Aquifers were subjected to Temporal Abstraction and Recharge);
- Simulate Groundwater Flow into Underground Mine workings and water level impacts over time according to a specified Mine Plan and Schedule (2016-2047);
- Simulate the rebound of the water levels post-mine closure up to 2097 (50-years post-mine closure);
- Simulate the feasibility to source the raw water supply from the Basal Sandstone over the Life of Mine together with water level impacts;
- Simulate the water inflow into the first Underground Mine access decline (pre-mining over the period 2014-2016);
- Simulate the Impact of the mining infrastructure (TSF, Stockpile & WRD) on Groundwater Quality. This part of the study will be completed once the data from the geochemical study becomes available; and
- On completion of this work a calibrated groundwater flow model will be available which can be used to ascertain the groundwater impacts of future development scenarios and general groundwater management across the mine area.

The groundwater flow and mass transport modelling process depends on the physical properties of the site. For a numerical model to be useful as a predictive tool, it is necessary to integrate the physical geometry and properties of the site into the model. Controlling factors are the topography and relief, surface hydrology and rainfall, geology, together with the properties of the aquifer system.

The concession (Permits 12873, 13025 and 13026) covers an elongated north south area of about 200km^2 and comprises a gently undulating, wooded terrain with open grasslands in Dilungu areas.

5.9.3 Hydrogeological Context

See section 5.8 for the hydrogeological context.

5.9.4 Conceptual Model

The first step in the modelling procedure is the construction of a conceptual model of the problem and the relevant aquifer domain. The conceptual model consists of a set of assumptions that reduce the real problem and the real domain to simplified versions that are acceptable in view of the objectives of the modelling and of the associated management problem.

The data gathered during the desk study and data evaluation phase of the study has been used to develop a hydrogeological conceptual model for the area, which forms the basis for the numerical modelling. A graphical representation of the conceptual model is depicted in Figure 56.

In a typical hydrogeological setting groundwater flow and aquifer development are closely linked to the geology and structural geology of an area. There is no reason to believe that the area under investigation will not conform to this assumption and therefore the geology as depicted in Figure 55 forms the basis on which the conceptual hydrogeological model is based. The nature and distribution of the geological units, and the geological structures control the hydrogeology of the study area.

The geology underlying the study area consists vertically (top to bottom) mainly of:

- A thick sequence of moderate to high permeable fractured Diamictite;
- Low permeable Pyritic siltstone;
- Low permeable Lower Diamictite (glacial till) - the mineralised zone occurs within the Lower Diamictite;
- Highly permeable Footwall sandstone;
- The geological sequence forms an anticline trending northeast to southwest;
- The aquifers consist of:
  - An Upper aquifer consisting of Upper Diamictite;
  - A Lower aquifer in basal footwall sandstone;
  - The KPS & mineralised lower Diamictite separates the 2 aquifers;
  - A regional aquifer occurs in the basal sandstone – this aquifer is targeted for a bulk water supply source; and
  - Recharge to the aquifer is from precipitation during the rainy season. This has been confirmed by comparing the water level fluctuations observed since 2010 with the cumulative rainfall departures from the mean rainfall series (CRD). A good correlation is obtained.
- Groundwater flow is from areas of higher piezometric elevations to lower elevations. Groundwater flow directions mimic the surface topography in the Upper Diamictite aquifer. This is confirmed by the correlation between groundwater levels and the surface topography (Figure 56). Since there is a correlation between groundwater elevation and surface elevation the surface elevation plays an important role in the study and forms the uppermost boundary of the modelling domain. As noted groundwater flow is generally from east to west along the surface drainages.

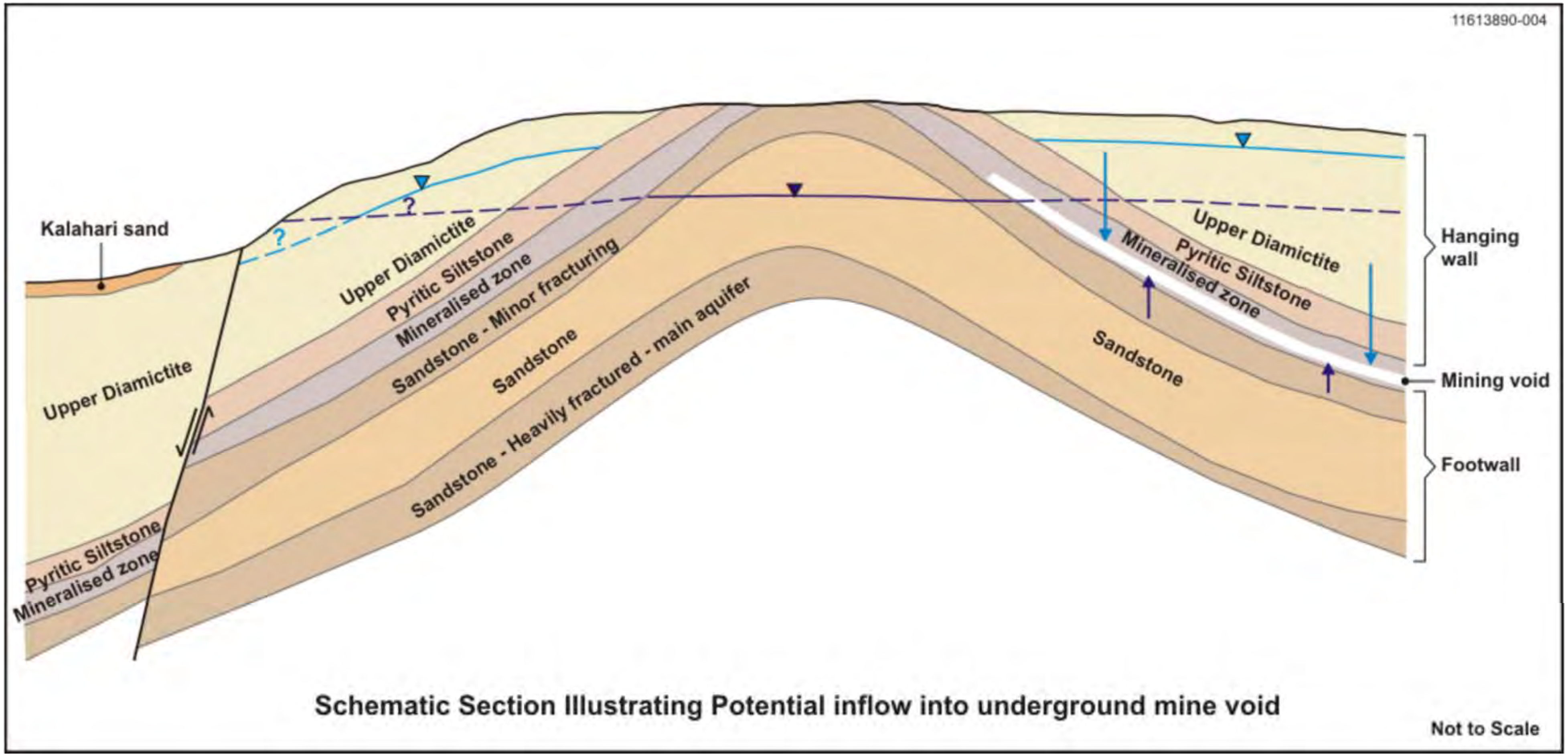


Figure 55: Schematic section through the anticline to depict formations and aquifers

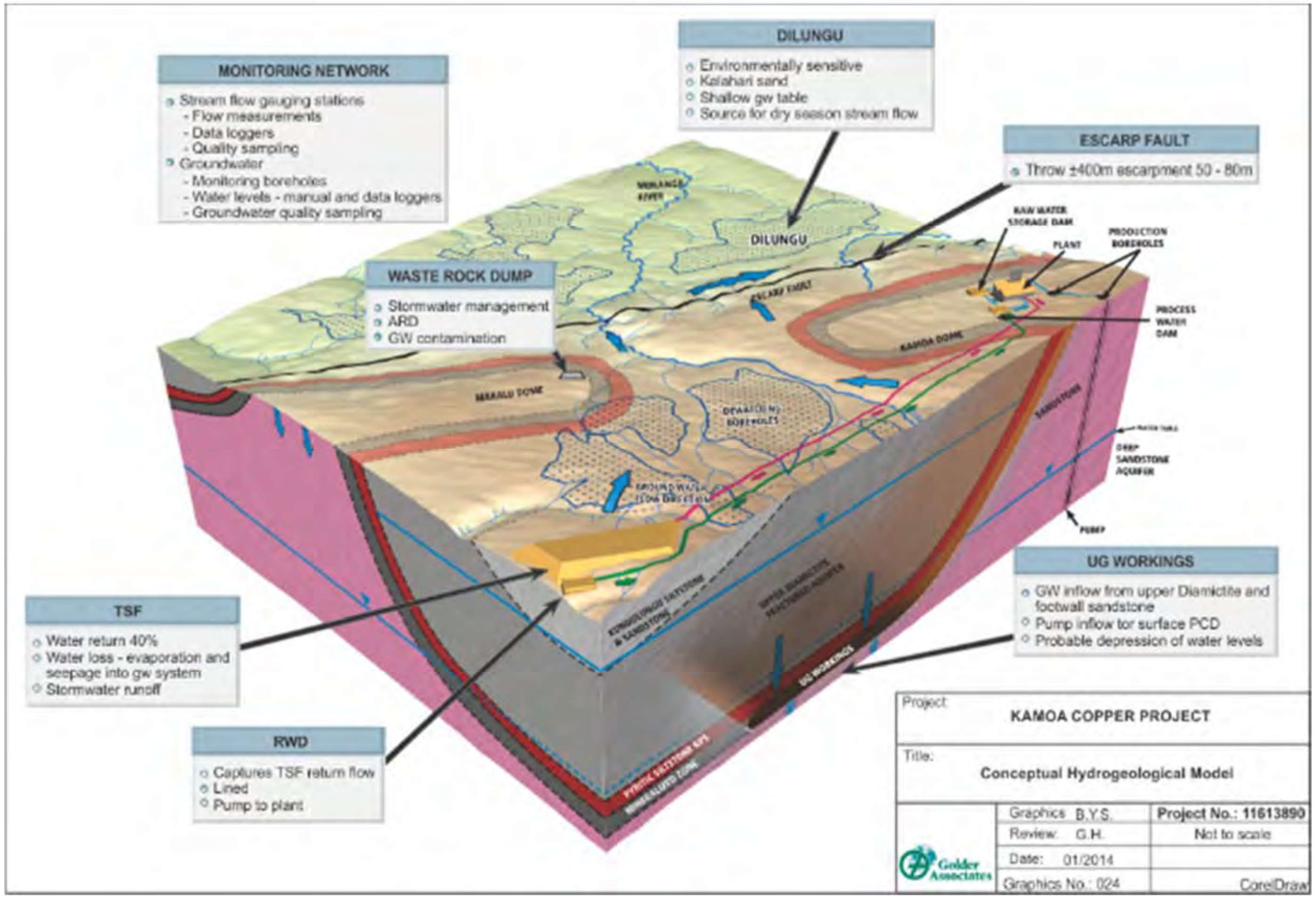


Figure 56: Conceptual Hydrogeological Model

5.9.4.1 Digital Code utilised

A steady state groundwater flow model for the study area was constructed to simulate undisturbed groundwater flow conditions. These conditions serve as starting heads for the transient simulations of groundwater flow where the effect of mining will be taken into consideration.

A dynamic flow model using the modelling package Feflow (Diersch, 1979) was constructed for the study area. The simulation model (Feflow) used in this modelling study is based on three-dimensional groundwater flow and may be described by the following equation:

$$\frac{\partial}{\partial x}\left(K_x\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_y\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_z\frac{\partial h}{\partial z}\right)\pm W=S\frac{\partial h}{\partial t} \qquad (1)$$

Where

h = hydraulic head [L]

Kx,Ky,Kz = Hydraulic Conductivity [L/T]

S = storage coefficient

t = time [T]

W = source (recharge) or sink (pumping) per unit area [L/T]

x,y,z = spatial co-ordinates [L]

The numerical model encompasses the catchment areas spatially encompassed by the Kamoa project area and extends to cover a total area of 464 square kilometres.

A finite element network (grid) was designed to provide a high resolution of the numerical solution, while at the same time, accommodating the large model area.

The finite element grid was compiled using the FEFLOW pre-processing software, which facilitated the construction of 6-noded triangular prism elements over the area of investigation as shown in Figure 57. The triangular grid consists of 378 738 elements and 213 410 nodes. The positions of the different geological units and structures are incorporated in the modelling grid as well as the various surface catchments. The model consists of nine layers and ten slices. The elevation of the top slice was set equal to the topographic elevation. Element sizes vary from 200m to less than one metre at the positions of the pumping boreholes. A zoomed picture of the model network is shown in Figure 58. A 3D-view of the modelling area is provided in Figure 59. Internal seepage face boundaries are depicted in Figure 60.

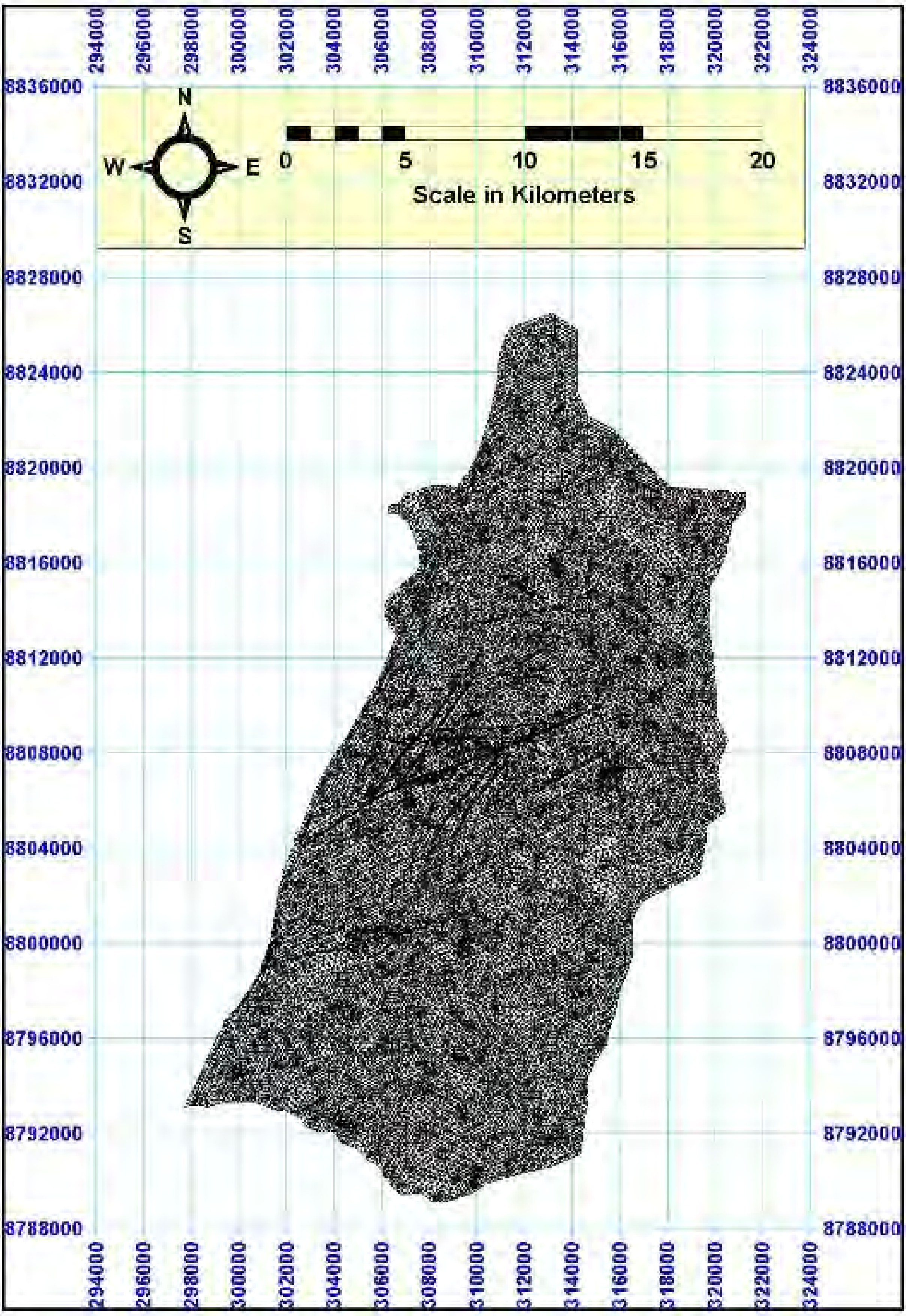


Figure 57: Finite Element network

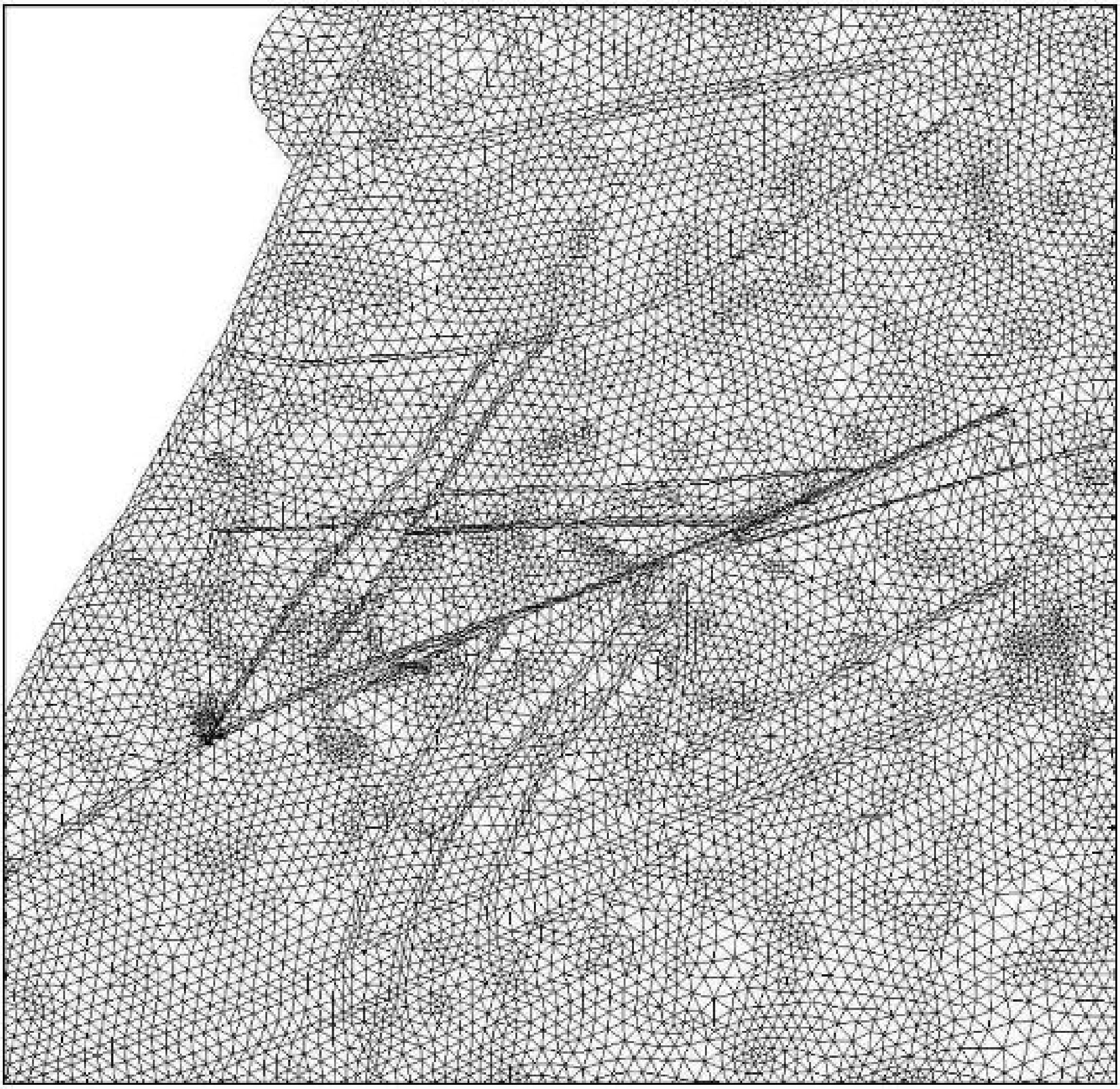


Figure 58: Zoomed picture of the Finite Element network

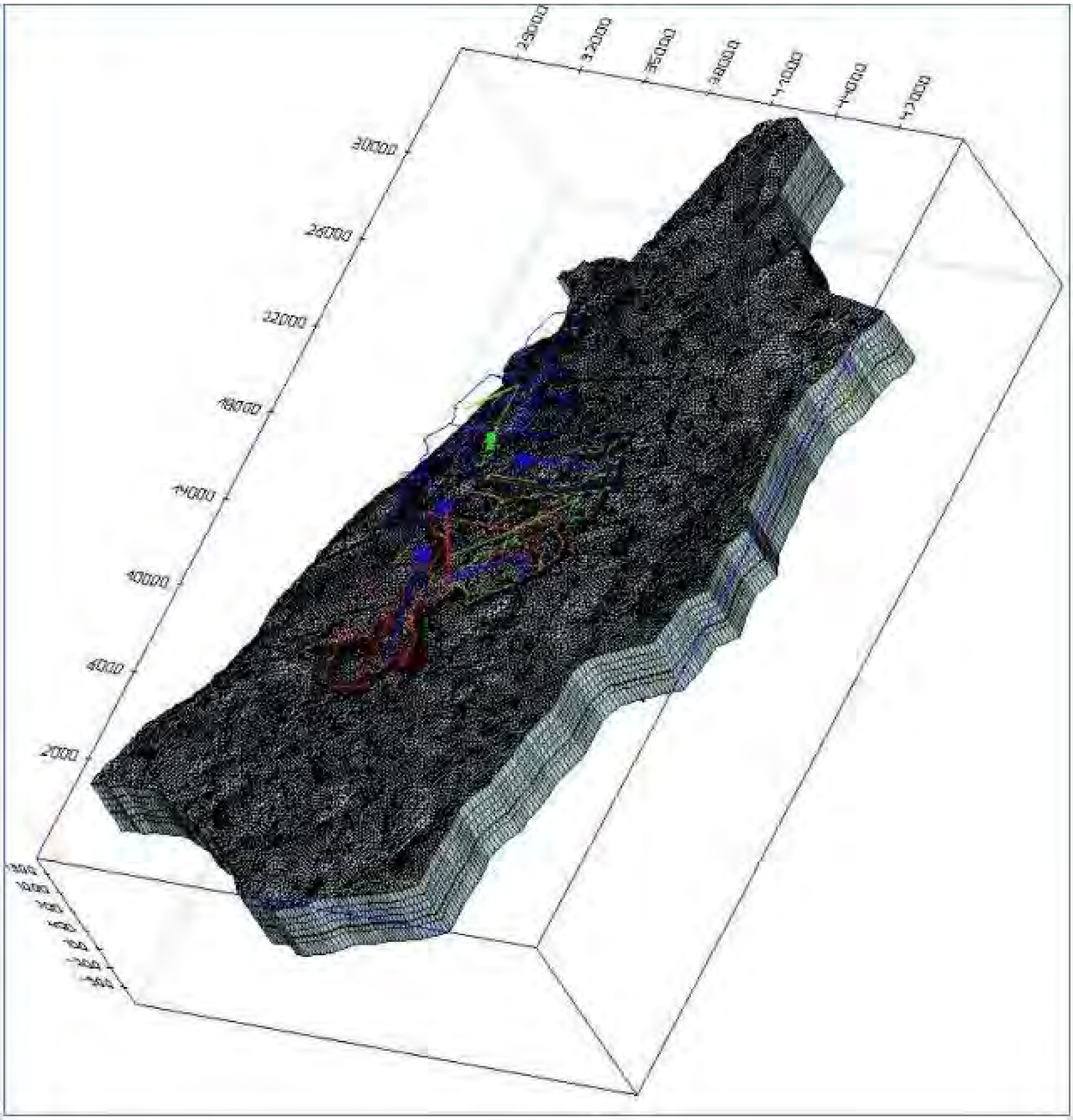


Figure 59: Kamoa Copper Project: 3D view of Finite Element network

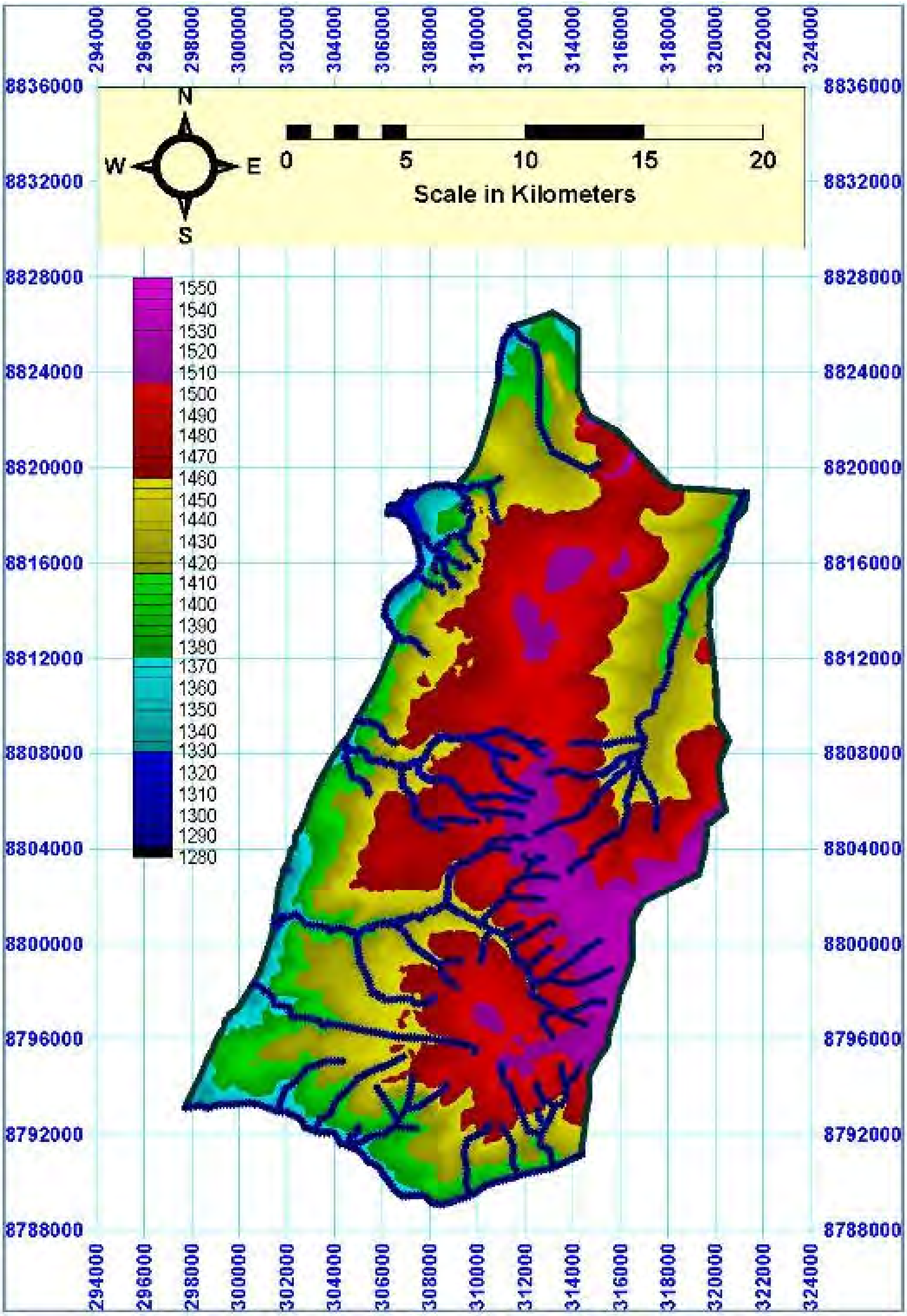


Figure 60: Internal seepage face boundaries shown as blue circles

5.9.5 Trial of the Model and a Sensitivity Analysis

Calibration is the process of finding a set of parameters, boundary conditions, and stresses that best reproduce the observed water levels and/or fluxes (Anderson and Woesner, 1992). A standard trial-and-error approach to calibrate the model was used.

Theoretically, hydraulic conductivity, hydraulic stresses (such as recharge rates from precipitation), and the hydraulic boundary conditions can be modified until the best possible match is made to the observed water level conditions. The water level data collected were used for steady state model calibration purposes.

After the set of parameters that resulted in the best match to the observed water levels was determined, a sensitivity analyses was performed. A sensitivity analyses is important to quantify the uncertainty in the calibrated model caused by uncertainty in estimates of the model input parameters. Results were found to be sensitive to the values of particular model parameters. This uncertainty, therefore, has to be taken into account when evaluating the model predictions. Hydraulic conductivity and hydraulic stresses (groundwater recharge) were tested and the model response was noted. As part of this process, better combinations of parameters were found to result in a better model calibration and the sensitivity analyses was repeated on the new calibration.

After calibration against observed water levels and testing data four scenarios were modelled using the preliminary mine plan (it should be noted that this mine plan is currently being changed and the model excludes the Kakula area) and the following KPS/Lower Diamictite hydraulic conductivities:

- Scenario 1: $K = 1 \times 10^{-11}$ m/s - based upon the current Model Calibration of the Upper Diamictite and Basal Sandstone Water Levels. This scenario is considered the “Best Case”;
- Scenario 2: $K = 6.4 \times 10^{-10}$ m/s - based on the “maximum K-value” for KPS/Lower Diamictite before the current model calibration results become completely unrealistic. This scenario is considered the “Realistic to Worst Case”;
- Scenario 3: $K = 1.16 \times 10^{-8}$ m/s - based on the K-value obtained from the 2 boreholes drilled and tested in the KPS/Lower Diamictite. This scenario is considered an “Unrealistic Case”; and
- Scenario 4: $K = 6 \times 10^{-11}$ m/s - based on the median K-value for Diamictite, tillite and siltstone obtained from a literature survey. This scenario is considered the “Probably most Realistic Case”.

5.9.6 Results and Predictions

In summary the groundwater modelling showed the following:

- The groundwater movement and hence the model are very sensitive to the hydraulic conductivity values of the KPS/Lower Diamictite; and
- The current modelling results indicate a widening range of groundwater inflow into the underground workings with time, as shown in Figure 61.

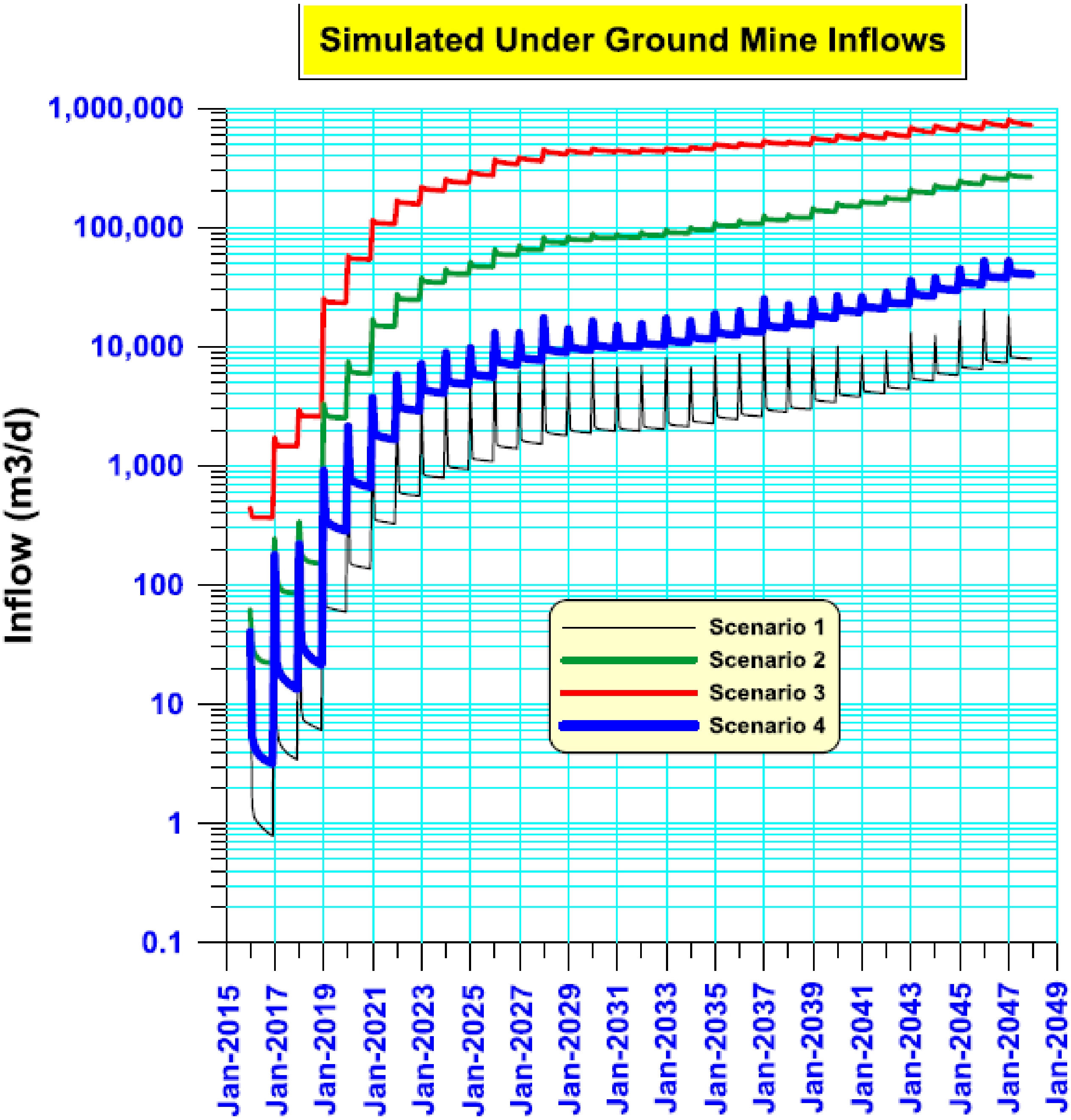


Figure 61: Simulated Groundwater Inflow to Underground Working at Kansoko

The following can be calculated from Figure 61:

- Scenario 1: UGM inflow is1.5 l/s per km^2 of mining after 30 years (Best case);
- Scenario 2: UGM inflow is 50 l/s per km^2 of mining after 30 years (Realistic to worst case);
- Scenario 3: UGM inflow is 140 l/s per km^2 of mining after 30 years (Unrealistic case); and
- Scenario 4: UGM inflow is 7 l/s per km^2 of mining after 30 years (Probably most realistic case).
- Simulation of inflows into the access decline indicates that up to 60l/s can be expected. This has highlighted the importance of pre-grouting of the decline in order to minimize water handling issues; and

- The model has confirmed, on the basis of the current understanding of the hydraulic condition of the basal sandstone aquifer, that the basal sandstone aquifer will be able to sustain the required abstraction to satisfy the bulk water supply for the mine.

5.9.7 Limitations of the Model

It is important to note that:

- The simulated underground mine inflows have been predicted using the preliminary 30 year mining plan for Kansoko only and will need to be expanded to include Kakula.
- The simulations do not consider any mitigation (e.g. backfilling of the mining void).
- With regard to informing pumping capacity to handle the inflows, a better understanding will be achieved once the model is updated with the improved KPS/Lower Diamictite permeabilities and the backfilling.
- The model will require to be updated following changes to the mine plan and expanded to include the Kakula mine plan going forward.

5.9.8 Summary and Conclusions

The following are the main findings from the modelling undertaken:

- It is demonstrated that the model is very sensitive to the hydraulic conductivity values of the KPS/Lower Diamictite;
- The current modelling results indicate a widening range of groundwater inflow into the underground workings with time. With regard to informing pumping capacity to handle the inflows, a better understanding will be achieved once the model is updated with the improved KPS/Lower Diamictite permeabilities and the backfilling;
- The model has confirmed, on the basis of the current understanding of the hydraulic condition of the basal sandstone aquifer, that the basal sandstone aquifer will be able to sustain the required abstraction to satisfy the bulk water supply for the mine; and
- Simulation of inflows into the access decline has highlighted the importance of pre-grouting of the decline in order to minimize water handling issues.

The numerical flow model described above provides the platform for future updating, refinement and scenario prediction to assist with future mine planning and water management. It is noted that the calculations of groundwater inflow into the underground mine have been made on the basis of the preliminary mine plan prepared in mid-2013, and hence at this stage the inflow predictions are indicative of the order of magnitude of inflow that must be planned for.

The following forward programme is to be undertaken when the relevant information becomes available:

- Update the model with the updated 2017 mine plan:
  - Incorporate the mining sequence in more detail into the model;
  - Incorporate backfill into the model;
  - Include the remainder of the access declines;
  - Update the KPS/Lower Diamictite permeabilities with packer test results;
  - Expand the model to include Kakula; and
  - Re-calculate mine inflows.
- Undertake groundwater quality impact modelling to confirm current groundwater quality impact predictions.

5.10 Radiation

A radiological assessment was undertake by the Nuclear Energy Company of South Africa (NECSA) in March 2013 for Kamoa (NECSA, 2013). The assessment obtained a broad overview of the current radiological status of the Kamoa Copper project area which included numerous villages inside the project area. In order to perform a complete radiological baseline survey the external exposure pathway (gamma radiation from soil surface) and internal exposure pathway (alpha and beta radioactivity of materials that could be inhaled or ingested) were identified as important and were covered in the survey.

Radiological survey strategy

The strategy was to perform gamma radiation measurements on soil surfaces (external pathway) by using calibrated gamma radiation detection equipment i.e. a Sodium Iodide Spectrometer and a Geiger Muller counter. To cover the internal exposure pathways radionuclide analysis on soil, sediment, water, vegetation, radon gas and airborne dust samples were performed.

Survey results and international guidelines

All results obtained during the survey were evaluated against international standards and guidelines. These guidelines indicate that background radioactivity and radiation levels are generally non-controllable but that enhanced levels above background, caused by human activities, should be controlled. For this reason baseline conditions prior to mining activities should be determined. These baseline values will also be compared with global background levels to determine whether the area has an enhanced background relative to global conditions.

Gamma spectrometric survey results of the Kamoa Copper Project obtained were comparable with global background levels; i.e. did not relate to enhanced natural background levels and hence posed no enhanced background radiological risk to the public.

Radiochemical analysis results of the Soil, Water, Sediment, Vegetation, Radon and Airborne Activity which represents the Internal Radiation Pathway were comparable with international guidelines and hence posed no enhanced background radiological risk to the public.

6.0 CHAPTER III: DESCRIPTION OF BIOLOGICAL ENVIRONMENT

As per the requirments of the mining code the following species lists were evelauate dto identify whether protected species existed at Kmaoa:

Table 34: List of Protected Animals as per Article 4 of Annex XII

Latin Name	Common Name	Found on Concession
A. MAMMALIA	**A. MAMMALS**	
A.1. Primates	**A.1. Primates**	
Gorilla gorilla spp.	Mountain and lowland gorilla	No
Pan troglodytes	Light-faced chimpanzee from the left bank of the river	No
Pan paniscus	Dwarf chimpanzee	No
A.2. Proboscidea	**A.2. Proboscidians**	
Loxodonta africana africana	Savanna elephant	No
Loxodonta africana cylotis	Forest elephant	No
Loxodonta africana purillis	Dwarf elephant	No
A.3. Perissodactyla	**A.3. Perissodactyls**	
Equus burchelli hippotigris	Burchell's zebra	No
Ceratotherium simum cottoni	White rhinoceros	No
Diceros bicornis	Black rhinoceros	No
A.4. Artiodactyla	**A.4. Artiodactyls**	

Latin Name	Common Name	Found on Concession
Giraffa camelopardalis	Giraffe	No
Okapia johnstoni	Okapi	No
Oreotragus oreotragus	Klipspringer	No
Taurotragus oryx	Cape eland	No
Taurotragus derbianus	Derby eland	No
Onotragus smithemani	Cobe Lechwe	No
Tragelaphus strepsiceros	Greater kudu	No
Aepyceros melampus	Katanga impala	No
Hyemoschus aquaticus	Water chevrotain	No
A.5. Carnivora	**A.5. Carnivores**	
Felis (Profelis) aurata	Golden cat	No
Osbornictis piscivora	Water civet	No
Acinonyx jubatum	Cheetah	No
Felis caracal	Caracal	No
A.6. Sirenia	**A.6. Sirenia**	
Trichechus senegalensis	Water manatee	No
A.7. Tubulidente	**A.7. Tubulidentata**	
Orycteropus afer	Aardvark	Yes
B. PHOLIDOTA	**B. PHOLIDOTA**	
Manis gigantea	Giant pangolin	No
C. REPTILA	**C. REPTILES**	
C.1. Crocodyla	**C.1. Crocodiles**	
Crocodylus niloticus	Nile crocodile (L <1,50m)	No
Crocodylus cataphractus	Narrow-snouted crocodile or false gavial (L <1,50m)	No
Osteolaemus tetraspis	Armour-plated crocodile (L <0,50m)	No
C.2. Testudinata	**C.2. Tortoises**	
Curetta curetta	Loggerhead turtle	No
Dermochelys coriacca	Leathery turtle	No
Eretmochelys imbricata	Hawksbill turtle	No
Chelonia mydas	True turtle	No
D. AVES	**D. BIRDS**	
Afropavo congensis	Zaire peacock	No
Balaeniceps rex	Shoebill	No
Ciconia ciconia	White swan	No
Pseudochelidon cuvrystominus	Yellow-billed false swallow	No
Sagittarius serpentarices	Secretary bird	No
Vulturidae	Vultures (all)	No
Leptoptilus crumeniferus	Marabou	No
Bucorvus abyssinicus	Abyssinian land calea	No
Bugeranus carunculatus	Wattled crane	No
Balearica pavenina	Crowned crane	No
Psittacus erithacus	West African grey parrot	No
Prionops alberti	Yellow-helmeted prionops	No

Latin Name	Common Name	Found on Concession
Pseudocalyptemena granueri	Pseudocalyptemena	No
E. PISCES	**E. FISH**	
Caecobarbus	Mbanza-Ngungu blindfish	No

Table 35: List of Partially Protected Animals as per Article 5 of Annex XII

SCIENTIFIC NAMES	COMMON NAMES	Present in Concession
A. MAMMALIA	**A. MAMMALS**	
A.1. Primates	**A.1. Primates**	
Cercopithecus mitis spp	Silvery or blue monkey	No
Cercopithecus kandti	Golden monkey	No
Colobus spp	Colobus	No
Galago crassicaudatus	Large long-tailed lemur from Katanga	No
A.2. Carnivora	**A.2. Carnivores**	
Felis serval	Serval	No
Panthera pardus	Leopard	No
Panthera leo	Lion	No
Lycaon pictus	Cape hunting dog	No
A.3. Artiodactyla	**A.3. Artiodactyls**	
Syncerus caffer caffer	Cape buffalo	No
Syncerus caffer nanus	Dwarf buffalo	No
Syncerus caffer Cequinoctialia	Nile buffalo	No
Kobus defassa	Oily buck	No
Redunca redunca	Swimming redunca	No
Damaliscus korrigum	Sassaby or Tsessebe	No
Damaliscus sp	Damalisk	No
Sigmoceros lichtensteinii	Liechtenstein bubal	No
Alcephalus lewali	Leweley’s bubal	No
Ourebia ourebi	Oribi	No
Tragelaphus neriptus	Harnessed antelope	No
Tragelaphus eurycerus	Bongo	No
Hypotragus equinus	Roan antelope	No
Hypotragus niger	Blackbuck	No
Cephalophus sylvicultor	Woodbuck	No
Onotragus lechwe	Swamp buck or lechwe	No
Kobus megaceros	Mrs Grady’s buck	No
Kobus kob kob	Buffon’s buck	No
Redunca arundinum	Reed buck	No
Tragelaphus spekei	Sitatunga (Water guib)	No
Hylochoerus meinertzhageni	Giant forest hog	No
Potamochoerus porcus	River hog	No
Hippopotamidae	Hippopotamus	No
Phacochoerus aethiopicus	Warthog	No
A.4. Hydracoides	**A.4. Hyraxes**	

SCIENTIFIC NAMES	COMMON NAMES	Present in Concession
Procavia capensis	Rock hyrax	No
B. REPTILIA	**B. REPTILES**	
B.1.	**B.1.**	
Crocodylus niloticus	Nile crocodile (L <1,50m)	No
Osteolaemus tetraspis	Armour-plated crocodile (L >1,50m)	No
Crocodylus cataphractus	Narrow-snouted crocodile	No
B.2. Pholidota	**B.2. Pangolins**	
Manis temininckí	Land pangolin	No
C. AVES	**C. BIRDS**	
Tytonidae	Owls (22 species)	No
Cuprimulgidae	Nightjars (13 species)	Yes
Alcadinidae	Swifts (17 species)	Yes
Casmerodius albus	Herons	No
Melanophoys ardesiata	Slate-coloured bittern	No
Bubulcus ibis	Cattle egret	Yes
Buphagus africana	Ox-pecker	
Threskiornis aethiopica	Sacred ibis or white-headed ibis	No
Phoenicopterus antiquorum	Pink flamingo	No
Bucorvus caffer	Land calae	No
Erismatura maccoa	Erect-tailed duck	No
Habraetus spp	Eagle spp (13 species)	Yes

Table 36: Proected Plant Species as per Article 6 of Annex XII

A. PROTECTED PLANT SPECIES (Latin name)	A. PROTECTED PLANT SPECIES (common name)	Present in Concession
l'*Encephalartos laurentianus*	De Wild	No
l'*Encephalartos septentrionalis*	Dchweinf	No
le *Strophantus kombe*		No
Pericopsis elata		No
Diospyros grex		No
Diospyros canaliculata		No
Eremospatha		No
Encephalartos ituriense(*Cycadoceae)*		No
Juniperus procera		No
Diospyros wagemansii		No
Millettia laurentii (Fabaceae)		No
Julbernardia breynei (Caesalpiniaceae)		No
Gnetum africanum (Gnetaceae)		No
Morinda morindroides (Rubiaceae)		No
Entandrophragma angolense		No
Entandrophragma candollei		No
Entondraphragma cylindricum		No

A. PROTECTED PLANT SPECIES (Latin name)	A. PROTECTED PLANT SPECIES (common name)	Present in Concession
Entondrophragma utile (Meliaceae)		No
Terminalia superba (Combrelaceae)		No
Milicia excelsa (Moraceae)		No
Megaphrynium macrostachyum (Marantaceae)		No

6.1 Terrestrial Fauna and Birds

The following sections detail recorded species in the study area.

6.1.1 Mammals

Historically, the Katanga Region of the DRC had a diverse mammal community, with estimates of up to 200 different species including a full suite of small through to large taxa (Branch, 2008). It is likely however, that outside of protected areas, the vast majority of the region's large mammals have been extirpated by a combination of subsistence hunting (Branch, 2008) and large-scale habitat modification.

Five mammal species were recorded as occurring in the study area through direct observation, camera trapping, evidence of their presence (spoor, faeces etc.) or from anecdotal testimony during the 2016 field survey. These are Slender Mongoose (*Galerella sanguinea*), Scrub Hare (*Lepus saxatilis*), Chacma Baboon (*Papio cynocephalus ursinus*), Bushpig (*Potamochoerus larvatus*) and Large-spotted Genet (*Genetta maculata*). Several other mammal species have also been documented as occurring or potentially occurring in the area (see Golder, 2014), including various rodents, such as *inter alia*, Pouched Mouse (*Saccostomus campestris*) and a Musk Shrew species (*Crocidura* sp.).

In 2004 Malaisse conducted a mammal survey in the Kolwezi district (> 20 km around Kolwezi). Based mostly on interviews with rural inhabitants, he documented the presence of up to 29 mammal species (Malaisse, 2004), including several large taxa, such as Impala (*Aepyceros melampus*), Oribi (*Ourebia ourebi*), Common Reedbuck (*Redunca arundinum*) and Common Duiker (*Sylvicapra grimmia*). Considering the degree of habitat modification and subsistence hunting throughout the Kolwezi district and around Kamoa, it is considered highly unlikely that many of the larger mammal taxa noted by Malaisse (2004) are still present.

Table 37: Mammal species recorded during the study

Family	Scientific Name	Local Name	Conservation Status
Les mammifères			
Galagidae	*Galago Crassicaudatus*	Katonto Mpongo	Not Listed
	Galago senegalensis	Kabundji	Not Listed
Cercopithecidae	*Cercopithecus pygerythrus*	Nsange	Not Listed
	Papio Sp.	Kolwe	Not Listed
Lycaonidae	*Lycaon pictus*	Muwumbu	Not Listed
Bovidae	*Tragelapohus spekei*	Mbuli	Not Listed
	Raphicerus Sp.	Kabuluku	Not Listed
	Redunca arundinum	Swala	Not Listed
	Cephalophus silvicultor	Kabuluku	Endangered
	Sylvicapra Grimmis	Kashis	Not Listed
Mustelidae	*Aonyx Capensis*	Kakonge	Not Listed
	Mungos Mungo	Twite	Not Listed

Family	Scientific Name	Local Name	Conservation Status
Les rongeurs			
Thryonomyidae	*Thryonomys sp*	Senji	Non repris
			Non repris
Leporidae	*Lepus capensis*	Kalulu	Non repris
	Lepus saxatilus	Idem	Non repris
Muridae	*Aethomus sp*	Kishe	Non repris
Hystricidae	*Hystrix africae sp*	Nungu	Not Listed

6.1.2 Birds

The study area falls within the Zambezian region as described by White (1983), incorporating much of Angola, Zambia, southern DRC, Malawi, western Tanzania, northern Mozambique and Zimbabwe. Sixty-four bird species are considered endemic or near-endemic to this biome, i.e. occurring nowhere else or only marginally elsewhere, of which 47 species occur in the DRC (Demey & Louette, 2001).

Southern DRC, north-eastern Angola and northern Zambia are considered to be the most species-rich areas within the Zambezian region, supporting over 90% of the miombo endemics (Dowsett-Lemaire and Dowsett, 2006).

A total of 156 bird species were recorded in the study are during the 2016 field visit. The most number of birds was recorded in the Tall Semi-deciduous Woodland (79 species), followed by the Secondary Woodland (52 species). Table 38 presents the number of bird species recorded during the 2016 field visit in the main vegetation communities.

Three bird species of conservation importance were recorded during the 2016 field visit, namely Wattled Crane (*Grus carunculata*) (VU), Bateleur (Terathopius ecaudatus) (NT) and Secretary Bird (*Sagittarius serpentarius*) (VU).

Table 38: Number of bird species recorded in the main vegetation communities

Vegetation Community	Number of birds species recorded
Swamp Forest	19
Riparian Forest	34
Tall Semi-deciduous Woodland	79
Secondary Woodland	52
Watershed Plains (Dilungu)	32
Riparian Wetland	39

Table 39: Avifauna species recorded during the study

Family	Scientific Name	Local Name	Conservation Status
Caprimulgidae	*Caprimulgus Natalensis* *Caprimulgus pectoralis fervidus*	Lubwata Lubwata	Not Listed
Pycnonitidae	*Pycnonotus barbatus*	Pwele	Not Listed
Ploceidae	*Passer grisens ugandae*	nsonkwe	Not Listed
Columbidae	*Streptopelia sp*		Not Listed
Bucherotidae	*Bucorvus leadbeateri*	Mungomba	Not Listed

Family	Scientific Name	Local Name	Conservation Status
	Tockus sp	Lukwekwe	
Hirundida	*Hirino claurica Emini*		Not Listed
Phasianidae	*Numida meleagris coronata*		Not Listed
Phasianidae	*Coturnix coturnix*	Nkwari ndembo	Not Listed
Accipitridae	*Hieraaetus fasciatus spilogasteur*	kibebankunku	Not Listed
Tytonidae	*Bubos africanus afriocanus*	Fwifwi	Not Listed
ploceides	*Picus viridis*	mubangwapopo	Not Listed
indicatorides	*Indicator indsicator*	mayimba	Not Listed
Otididae	*Ardeotis kori kori*	Kwale kalengani	Not Listed
Falconidae	*Falco subbuteo subbuteo*	Kabemba sanga	Not Listed

6.1.3 Herpetofauna

Southeast Katanga Province has a high reptile species richness and the isolated mountain plateaus of Upemba and Kundelungu are recognised as important centres of reptile and frog endemism. An analysis of zoogeographical affinities by Broadley & Cotterill (2004) indicates that the region's reptile diversity is derived from both forest and savanna assemblages, with over 119 reptile and about 64 amphibian species may be present (Branch, 2008; Broadley and Cotterill, 2004; Channing, 2001; IUCN, 2016).

Twenty three reptile and 11 species of amphibians were documented as occurring at Kamoa in Golder (2014). Some of the species recorded include the following reptiles Flap-neck Chameleon (*Chamaeleo dilepis*) (Figure 62), Cape Rough-scaled Lizard (*Ichnotropis capensis*) Keeled Plated Lizard (*Gerrhosaurus multileneatus auritus*) Green Water Snake (*Hilothamnus hopogaster*), and the amphibians Guttural Toad (*Amietophrynus gutturalis*), Common Rriver Frog (Amieta angolensis), Flat-backed Toad (Amietophrynus maculatus), Shovel-footed Squeaker (*Arthroleptis stenodactylus*), Cinnamon Tree Frog (*Leptopelis cynnamomeus*) and Plain Grass Frog (*Ptychadena anchietae*).

Figure 62: Flap-necked Chameleon (Chamaeleo dilepis)

Table 40: Reptile species recorded during the study

Family	Scientifc Name	Local Name	Conservation Status
Testudinidae	*Kinixys sp*	Bandakwe	Not Listed
Varanidae	*Varanus niloticus*	Samba	Not Listed
Viperidae	*Bitis gabonica gabonica* *Bitis arientas arientas*	Moma Kipili	Not Listed
Boidae	*Python sebae*	Lusato	Not Listed
Larcetidae	*Lacerta jacksonie*	musorio	Not Listed

6.1.4 Amphibia

A total of 110 amphibian species are known to occur within the Katanga region in which the study was conducted (Table 41). Eleven (11) species of amphibians were recorded as occurring within the study area and are given in (Table 11). These species are not restricted in terms of habitat or distribution and none of the species recorded are classified as Red Data species or protected as per DRC legislation. Most of the species recorded were hydrophilic species and thus recorded in or near waterbodies. Species less dependent on water were recorded in Miombo Woodland areas or other terrestrial habitats.

Table 41: Amphibian species recorded during the study

Family	Scientific name	Locla Name	Conservation status
Bufonidae	*Bufo regularis regularis*	Kiula	Not listed
Ranidae	*Rana occipitalis*	Musompo	Not listed

6.1.5 Aquatic Fauna

In 2010, a study was conducted by African Minerals (Barbados) Limited and identified five sampling sites where a total of 9 fish species were recorded. In June and November 2012, Golder undertook a study with fourteen sampling sites across the Kamoa, the Mukanga, and the Lulua river systems (Figure 63). Further to this, in October 2016 an assessment of eight (8) sites within the Lulua, Mulungwishi and Tchimbundji Rivers (Ngulube and Masengu tributaries) was conducted (Figure 63). In addition to the project site, four (4) river sites were also visited for the proposed road between Kolwezi and the Kamoa Project Area (Figure 64).

Water levels were similar during both the June and November 2012 surveys despite seasonal differences. November is the beginning of the rainy season in the Kolwezi area and due to a recharge lag, the rivers had not yet risen. During the October 2016 survey, the water levels were noted to be low as a result of it being the end of the dry season. A summary of the results obtained during the June and November 2012, October 2016 as well as the 2010 Kamoa surveys is provided below:

- In situ water quality is generally not a limiting factor to aquatic biota and although the dissolved oxygen (mg/ℓ) and percent saturation (%) results measured were often below guideline values, no evidence of this limiting the abundance or diversity of species was present;
- The Total Dissolved Oxygen concentrations were low at most sites during the 2012 surveys, but as expected showed an increasing trend in a downstream direction. During the October 2016 survey, concentrations were adequate;
- It was noted that the low conductivity did inhibit electrofishing efficiency at some sites;
- The pH value at site KAM01 during the June 2012 survey fell below guideline values, while in November 2012 site MUK05 exceeded the range. During the November 2012 survey pH values were more alkaline than during June. During the October 2016 survey, all sites were alkaline and within guideline ranges;
- The habitat availability varied at all of the sites and longitudinally down the respective rivers as flow and substrate changed. A general description of the integrity however showed that the instream habitat was generally natural with few localised disturbances from local villages utilising the resource.

Some of the sites lacked the stones-in-current biotope, while sites with rocky substrates and a dense canopy lacked the instream vegetation;

- Many accessible open bodies of water are used for soaking cassava, a staple food for local people. The cassava is placed in bags and left in the water to soak. The soaking of cassava is known to impact water quality as it releases cyanide in the process (Cereda and Takahashi, 1996; Nebiyu and Getachew, 2011). The rivers within the project area are also important sources of drinking/ cooking water for local communities as well as points for bathing and washing clothes;
- Based on an assessment of the aquatic macroinvertebrate community, a general increasing trend in the percent contribution of EPT taxa was observed in a downstream direction. Flow velocity and substrate changes were the major drivers contributing to this trend;
- During the 2012 surveys, the most commonly observed taxa throughout the project area were Chironomidae (Midges) and Gomphidae (Clubtails). During the October 2016 survey, Chironomidae (Midges) and Coenagrionidae (Sprites and blues) were the most commonly observed taxa;
- Although not a strong trend, the total number of taxa observed in the Kamoa and Lulua Rivers showed an increase in a downstream direction, however the Mukanga River interestingly showed a decrease from site MUK02 downstream during the 2012 surveys. This trend may be associated to the substrate where gravel/ pebbles (MUK02) are found in the upper reaches, boulders in the middle reaches (MUK05) and bedrock in the lower reaches (MUK06);
- The ichthyofaunal assessment has showen a diverse community with 33 species being captured to date. As very little work has been done within the project area, many species have adopted names from similar species known or recorded elsewhere. It will take time to classify and rename species, but this study provides the opportunity for this to be done. During the 2012 sampling activities, 27 species were recorded. The most abundant fish species sampled in the project area during the 2012 sampling cycle was Enteromius (Barbus) miolepis (Zigzag barb), followed by Enteromius (Barbus) neefi (Sidespot barb) and Kneria stappersii (Shell-ear). The diversity of the ichthyofaunal communities within the Lulua and Mukanga Rivers increased in a downstream direction during both the June and November 2012 surveys. The Kamoa River showed the lowest overall species diversity and did not show a prominent trend like the other two rivers. The highest diversity recorded in the Kamoa River was at the furthest downstream site where the habitat was the most diverse. During the October 2016 survey, 23 species were captured, with the most abundant species remaining Enteromius (Barbus) miolepis (Zigzag barb);
- No known red data species were captured and the sampled specimens indicated a healthy population, with the exception of parasites on 2 individuals; and
- It should also be noted that in the Project area, some species of aquatic fauna are well known to the inhabitants by their local (vernacular) names as follows:

Table 42: FIsh Species Identified at Kamoa

Family	Scientific Name	Local Name	Conservation Status
Cyprinidae	*Barbus neefi* *Barbus* *eutenia*	Kasepa matula	Not listed
Characidae	*Aleste bimaculatus*	Kiaka	Not listed
Cichlidae	*Haplochromispolyacanthus* *Oreochromis niloticus* *O.rendali*	Makoki Makoki Samba	Not listed
Characidae	*Alestes sp*	Tukoko	Not listed

6.1.6 Protected Fauna

Fauna species of conservation importance recorded in the area are listed in Table 43.

Table 43: Fauna species of conservation importance species that may occur in the study area

Scientific name	French name	English name	Conservation Status
Bucorvus leadbeateri	Calao terrestre de Leadbeater	Southern Ground Hornbill	Vulnerable (VU)
Terathopius ecaudatus	Aigle bateleur	Bateleur	Near threatened (NT)
Bubulcus ibis ibis	Héron garde-boeuf	Cattle Egret	Protected (DRC)
Balearica regulorum gibbericeps	Grue couronnée	Crowned Crane	Endangered (EN)
Orycteropus afer	Oryctérope; Cochon de terre	Aardvark; Antbear	Protected DRC
Upupa epops africana	Huppe	African Hoopoe	Not Listed

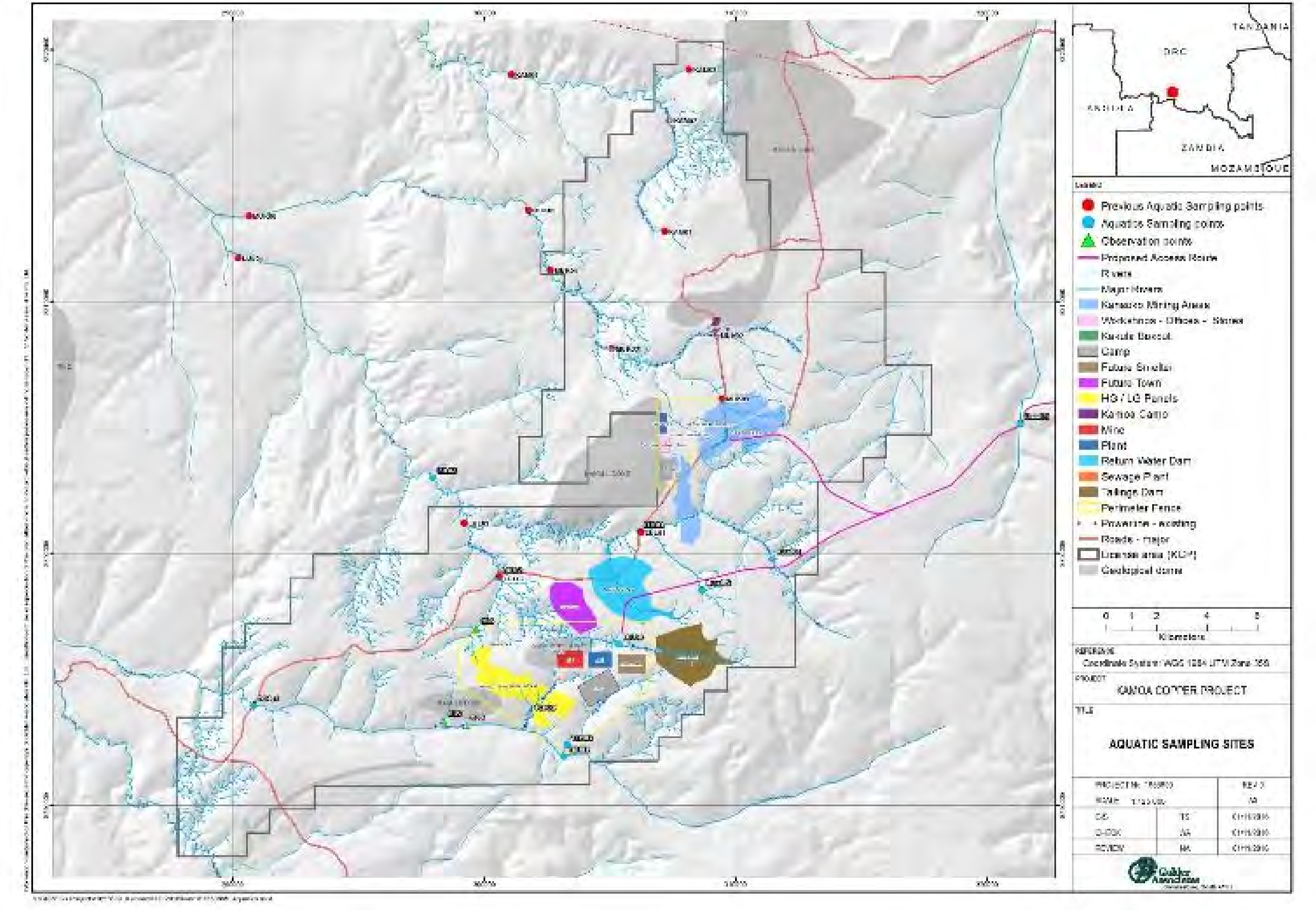


Figure 63: Aquatic Sampling Site

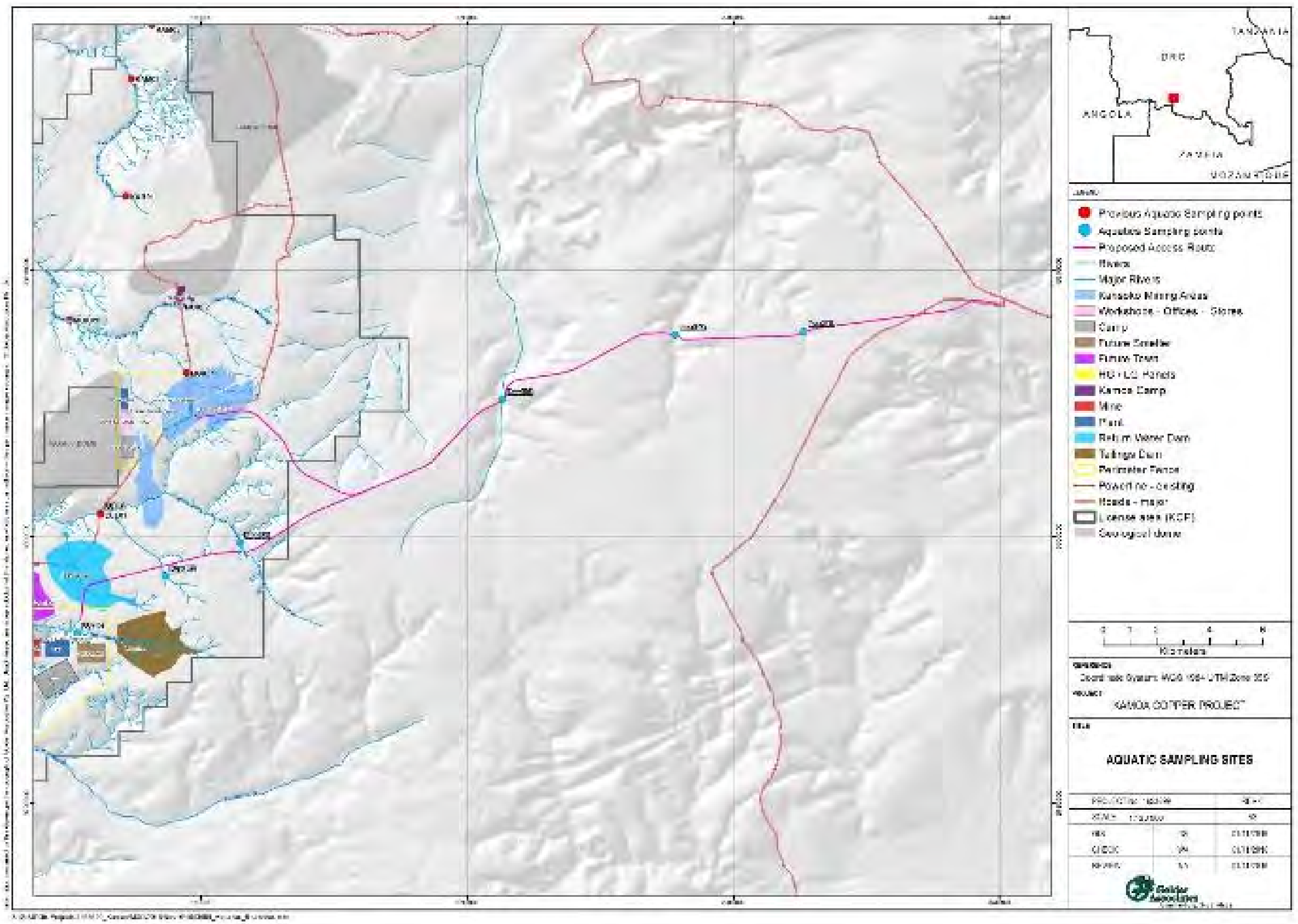


Figure 64: Aquatic Sampling Site - Access Road Area

6.2 Terrestrial Flora

This section presents a broad overview of the prevailing ecological characteristics at a regional-scale, based on published literature and data.

6.2.1 Zambezian Phytoregion

The region of the southern DRC in which Kamoa is located is within the Savanna Biome, and more specifically the Zambezian Phytoregion (phytochorion[2]) (Chidumayo, 1997). This phytoregion, otherwise referred to as the Zambezian Regional Centre of Endemism (*sensu* White 1983), characterises the high, ancient African erosional surfaces that extend throughout much of the central southern African subcontinent (Scholes and Walker, 1993).

Unlike savannas on the lower Post-Africa erosional surfaces, the African erosional surface savannas are cooler, wetter and generally nutrient poor and acidic as a consequence of leaching (Byers, 2001; Scholes and Walker, 1993). These 'infertile' savannas are characterised by a dominance of broad-leaf woody plants of the *Caesalpiniaceae* and *Combretaceae* families (Scholes and Walker, 1993).

The Zambezian Phytoregion comprises several broad vegetation types, namely: dry forest, swamp and riparian forest, Mopane woodland and scrub, Munga woodland and scrub, Chipya woodland, Miombo woodland, thicket and grassland (Chidumayo, 1997). Kamoa is located in the Miombo woodland vegetation type.

6.2.2 Miombo Woodland

Miombo woodland is the largest vegetation type in the Zambezian Phytoregion, covering approximately 270 million ha (70%) (Chidumayo, 1997). Leguminous trees from the Caesalpinioid genera *Brachystegia, Isoberlina*, and *Julbernardia* are the dominant species. These taxa are highly gregarious and rarely occur in other vegetation types (White, 1983). The dominance of one subfamily of trees provides the unifying feature of the miombo ecosystem. Miombo trees are frost sensitive - a factor that likely defines the southern limit of the vegetation type. Miombo woodlands are mostly semi-deciduous, although completely deciduous and evergreen variants do occur (White, 1983).

White (1983) indicates that miombo occuring on shallow or rocky soils, such as those on steep slopes and hills, are probably little modified from their natural state. However, miombo occuring on deeper soils of plateau regions are likely to be highly modified as a result of agriculture. He postulates that in these areas, the composition and structure of miombo woodlands are homogenised, with trees generally having a uniform age and size structure, as determimed by the local cultivation cycle.

Apart from a number of canopy associates, several species of *Uapaca*, *Monotes* and *Protea* are common and often co-dominant in secondary miombo woodland or in the scrubland ecotone between woodlands and edaphic grasslands (i.e. dambos') (White, 1983). In general, the woodland structure is between 6 to 20 m in height and ranges from 20% canopy cover to an almost closed-canopy cover (Byers, 2001).

In woodlands disturbed by fire or agriculture, the herbaceous layer is usually dominated by tall (>2 m), woody *Andropogneae* grasses. These areas are often refered to as secondary woodland or wooded grasslands (White, 1983).

Despite the overall dominance of *Caesalpiniaceae* trees in miombo, the relative contribution of different miombo species varies extensively between and within communities. In his characterisation of Africa's vegetation, White (1983) divided miombo woodland into dry (<1 000 mm annual rainfall) and wet (>1 000 mm annual rainfall) types. This division was futher subdivided by Chidumayo (1997) into four subtypes, of which the 'north-western wet miombo' varient typifies the regional vegetation of Kamoa. Co-dominant species in north-western wet miombo according to Chidumayo (1997) include *Brachystegia spiciformis, Brachystegia longifolia, Isoberlina angolensis, Julbernardia paniculata*, with species such as *Diplorynchus condylocarpon, Syzygium guineense* and *Uapaca* spp. common in the understorey.

[2] A geographic area with a relatively uniform plant species composition.

The nutrient-poor status of soils in miombo woodlands creates a protein-deficient landscape, resulting in generally low levels of herbivory (Byers, 2001) - grazer biomass is roughly 20% of the more fertile savannas. This, coupled with a lack of moisture during the long dry season, results in miombo woodlands being locked in a slow nutrient cycle, which, in turn, creates a 'high-carbon' landscape characterised by abundant woody biomass. Two prominent ecological pecularities arise because of this; firstly, fungal biomass and diversity is appreciably higher than other savannas; and secondaly, termites rather than large mammalian herbivores fufil the role of major landscape engineeers through high levels of vegetation consumption and the subsequent creation of small-scale nutrient-hotspots (Byers, 2001).

The conservation status of the broader Central and Eastern Miombo Woodlands Ecoregion, as defined by the World Wildlife Fund (WWF), is Vulnerable (WWF, 2016).

6.3 Terrestrial Flora at Kamoa

This section presents a summary of the vegetation characteristics of the Kamoa study area, and is based on field surveys undertaken on-site.

6.3.1 Vegetation Communities (Ecosystems)

Vegetation units recognised during the 2013 field programme of Kamoa and the recent 2016 field survey of the Kakula site were consolidated into 10 vegetation communities, under three broad structural formations (Forest/Thicket, Woodland and Grassland). These are (see Figure 65):

Forest/Thicket Formations

- Swamp Forest;
- Riparian Forest;
- Termitaria Thicket; and
- *Oxytenanthera* Thicket.

Woodland Formations

- Tall Semi-deciduous Woodland;
- Low *Uapaca* Woodland; and
- Secondary Woodland.

Grassland Formations

- Watershed Plains;
- Riparian Wetland; and
- Seepage Wetland.

Historically, the majority of the study area would have comprised Tall Semi-deciduous Woodland (Miombo). However, large-scale clearing of woodland by local communities for agriculture and charcoal production has occurred and is occurring throughout the study area and surrounding region. The result is a highly fragmented landscape, characterised by a mosaic of large tracts of Secondary Woodland in various stages of regeneration, and scattered pockets or elongated bands of undisturbed or less-modified habitat. This vegetation pattern is dynamic, with woodland clearing occurring on an almost continual basis. Fire is also widely applied in the area, and has in some areas, maintained vegetation in an open, secondary form.

A total of 359 plant species have been recorded on-site. The tall Semi-deciduous Woodland community is the most species rich community with 133 flora taxa recorded in (133 taxa). This is followed by Riparian Forest (94 taxa) and Watershed Plains (76 taxa). The least botanical rich community was the *Oxytenanthera* Thickets, with only two taxa recorded in this community (Table 44). Table 46 presents a list of some of the plant species recorded in the identified vegetation communities of these species only three are currently listed as IUCN listed Red Data flora species were recorded during the surveys, these species are given in Table 45.

Table 44: Number of plant taxa recorded in each vegetation community

Vegetation Community	Number of plant taxa recorded
Swamp Forest	28
Riparian Forest	94
Termitaria Thicket	25
Oxytenanthera Thicket	2
Tall Semi-deciduous Woodland	133
Low *Uapaca* Woodland	36
Secondary Woodland	51
Watershed Plains (Dilungu)	76
Riparian Wetland	30
Seepage Wetland	20

Table 45: IUCN listed Red Data and DRC protected species recorded during the study

Family	*Biological Name*	Copper flora	IUCN Status	Growth Pattern	Vegetation Community
Cyperaceae	*Ascolepis metallorum*	#	Endangered	Cyperoid	Hillslope Miombo/Degraded or Fragmented Miombo/Uapaca fringe
Fabaceae	*Pterocarpus angolensis*		Near Threatened	Tree	Natural Miombo
Meliaceae	*Khaya anthothaeca*		Vulnerable	Tree	Natural Miombo/Riparian forest

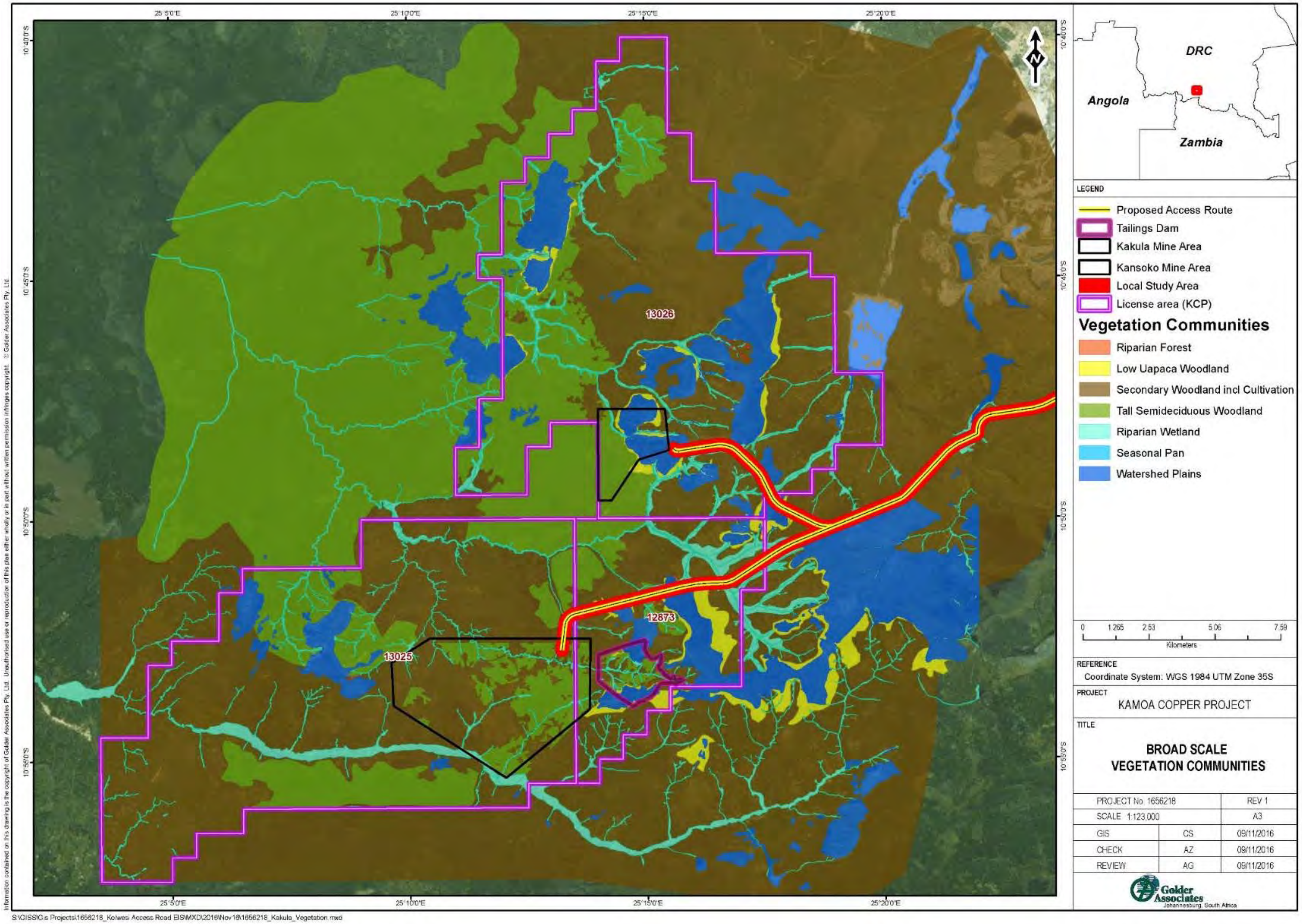


Figure 65: Vegetation communities/Ecosystems identified during the study

Table 46: A summary of some of the plant species recorded in the different vegetation communities at Kamoa

Structural Formation	Vegetation Community	Growth Form			
		Trees	**Shrubs**	**Suffrutex**	**Herbaceous plants (incl. geophytes, epiphytes, forbs, ferns & grasses)**
Forest/ Thicket	Swamp Forest	*Xylopia aethiopica, Rauvolfia caffra, Tabernaemontana pachysiphon, Voacanga thouarsii, Harungana madagascariensis, Anthocleista* spp., *Ficus* spp., *Syzygium* spp., *Bridelia micrantha*	*Dissotis hensii, Dissotis princeps* var. *princeps, Bertiera angusiana, Dracaena fragrans*	-	*Aframomum angustifolium, Brillantaisia madagascariensis, Otiophora pycnostachys, Diaphananthe fragrantissima, Aframomum angustifolium*
	Riparian Forest	*Xylopia* spp., *Tabernaemontana pachysiphon, Voacanga thouarsii, Garcinia smeathmannii, Harungana madagascariensis, Anthocleista* spp., *Ficus* spp., *Hymenodictyon floribundum*	*Uvaria angolensis, Strophanthus welwitschii, Acalypha chirindica, Entada gigas* (climber), *Dracaena fragrans,*	-	*Adiantum* spp., *Scadoxus multiflorus, Cyrtorchis ringens, Oplismenus burmannii,*
	Termitaria Thicket	*Cussonia arborea, Boscia angustifolia* var. *corymbosa, Combretum molle, Euphorbia ingens, Erythrina abyssinica, Ficus burkei, Ficus fischeri, Syzygium* spp., *Psydrax subcordata,*	*Diospyros lycioides* subsp. *sericea, Adenia gummifera* var. *gummifera* (climber), *Phyllanthus muellerianus*	*Syzygium guineense* subsp. *huillense*	*Chlorophytum* spp., *Anchomanes difformis, Oxytenanthera abyssinica, Setaria lindenbergiana*
	Oxytenanthera Thicket	-	-	-	*Oxytenanthera abyssinica, Pteridium aquilinum centrali-africanum*

Structural Formation	Vegetation Community	Growth Form			
		Trees	**Shrubs**	**Suffrutex**	**Herbaceous plants (incl. geophytes, epiphytes, forbs, ferns & grasses)**
Woodland	Tall Semi-deciduous Woodland	*Diplorhynchus condylocarpon, Parinari curatellifolia, Harungana madagascariensis, Monotes* spp., *Brachystegia spiciformis, Brachystegia wangermeeana, Isoberlinia angolensis, Albizia antunesiana, Albizia adianthifolia, Bobgunnia madagascariensis, Erythrina abyssinica, Pterocarpus angolensis, Ochna schweinfurthiana, Uapaca* spp.	*Indigofera podocarpa, Kotschya strobilantha, Memecylon flavovirens, Paropsia brazzeana, Xerophyta equisetoides, Protea micans* subsp. *trichophylla*	*Empogona cacondensis, Fadogia* spp., *Fadogiella stigmatoloba, Eriosema englerianum, Droogmansia pteropus, Dolichos kilimandscharicus, Cryptosepalum maraviense*	*Vernonia anthelmintica, Vernonia luembensis, Begonia princeae, Haumaniastrum caeruleum, Ocimum angustifolium, Hibiscus rhodanthus, Dorstenia benguellensis, Aneilema welwitschii, Murdannia simplex, Albuca abyssinica, Eragrostis* spp. *Hyperthelia dissoluta, Setaria pumila*
	Low *Uapaca* Woodland	*Terminalia mollis, Monotes discolor, Pterocarpus angolensis, Hymenocardia acida, Uapaca robynsii, Oldfieldia dactylophylla*	*Erica benguelensis, Protea madiensis,*	*Lannea edulis, Annona stenophylla* subsp. *longepetiolata, Parinari capensis* subsp. *capensis, Cryptosepalum maraviense, Droogmansia pteropus, Olax obtusifolia, Fadogia* spp.	*Hermbstaedtia angolensis, Pandiaka carsonii, Vernonia anthelmintica, Ocimum centraliafricanum, Hibiscus rhodanthus, Orthochilus aurantiacus*
	Secondary Woodland	*Anisophyllea boehmii, Diplorhynchus condylocarpon, Parinari curatellifolia, Combretum spp., Monotes africanus, Brachystegia spiciformis, Burkea africana, Albizia antunesiana*	*Annona senegalensis* subsp. *senegalensis, Tithonia diversifolia*, Harungana madagascariensis, Eriosema psoraloides, Paropsia brazzeana, Lantana camara**	*Lannea edulis, Xylopia tomentosa, Dolichos kilimandscharicus, Eriosema shirense, Fadogia* spp.	*Pteridium aquilinum* subsp. *centrali-africanum, Achyranthes aspera, Mechowia grandiflora, Crassocephalum rubens, Ocimum* spp., *Commelina schweinfurthii subsp. ceciliae, Eragrostis spp., Melinis repens, Smilax anceps, Aframomum* spp.

Structural Formation	Vegetation Community	Growth Form			
		Trees	Shrubs	Suffrutex	Herbaceous plants (incl. geophytes, epiphytes, forbs, ferns & grasses)
Grassland	Watershed Plains (Dilungu)	*Ochna* spp.	-	*Lannea gossweileri, Ozoroa marginata, Annona stenophylla* subsp. *longepetiolata, Magnistipula sapinii, Parinari capensis subsp. capensis, Combretum platypetalum* subsp. *oatesii, Cryptosepalum maraviense, Humularia bequaertii, Triumfetta welwitschii, Syzygium guineense subsp. huillense, Protea* spp.	*Blepharis cuanzensis, Justicia elegantula, Helichrysum* sp., *Crotalaria* spp. *Haumaniastrum* spp., *Sopubia* spp., *Polygala welwitschii* subsp. *pygmaea, Ascolepis* spp., *Alloteropsis semialata* subsp. *semialata, Andropogon eucomus* subsp. *huillensis, Diheteropogon amplectens, Eragrostis* spp., *Hyparrhenia bracteata, Hyperthelia dissoluta, Monocymbium ceresiiforme*
	Riparian Wetland	*Acacia polyacantha* subsp. *campylacantha*	*Harungana madagascariensis, Mucuna coriacea* (climber), *Polygala virgata* var. *decora*	-	*Pteridium aquilinum subsp. centrali-africanum, Centella asiatica, Crassocephalum uvens, Nidorella resedifolia, Cannabis sativa, Crinum macowanii, Eulophia* spp., *Andropogon eucomus* subsp. *huillensis, Hyparrhenia bracteata, Hyperthelia dissoluta, Imperata cylindrica, Phragmites australis, Smilax anceps*

Structural Formation	Vegetation Community	Growth Form			
		Trees	Shrubs	Suffrutex	Herbaceous plants (incl. geophytes, epiphytes, forbs, ferns & grasses)
	Seepage Wetland	*Syzygium cordatum*	*Pycnostachys stuhlmannii*	-	*Centella asiatica, Haplocarpha scaposa, Genlisea hispidula, Otiophora pycnostachys, Ascolepis* spp., *Brachycorythis angolensis, Eulophia angolensis, Andropogon eucomus, Aristida* sp., *Imperata cylindrica, Setaria incrassata*

6.3.1.1 Wetlands

In terms of wetlands, the following wetland types were identified within the study area (Figure 66):

- Seepage wetlands;
- Depression wetlands;
- Seepage wetlands with depressions;
- Depression wetlands with pans;
- Springs; and
- Floodplain wetlands.

Seepage Wetlands

Seepage wetlands typically comprise footslope seeps driven by subsurface seepage through the sandy catchment soils of the Pyrophytic Dwarf Shrublands. These occur mostly on the periphery of the swamp forests, and in some cases along the normal riparian forests. Driving processes are:

- Periodic inundation by surface runoff from the immediate watershed; and
- Sequential deposition of coarse material from the catchment during extreme storm events, followed by the long-term accumulation of fine colloidal material (clay, silt and organic matter) deposited during more frequent, gentle rainfall cycles.

Depression Wetlands

Numerous depression wetlands (Dambos) were identified within the study area and are typically associated with the Pyrophytic Dwarf Shrublands and are characterised by:

- Distinct basin-shaped, inward draining topography, often with no clear hydrological linkages to the drainage system (although there may well be subsurface linkages). In most cases there is no clear inlet or outlet for water;
- Mostly temporary wetland zone soil indicators;
- Dense herbaceous vegetation (sedge and grass species) comprising similar species to the seepage wetlands which promotes the infiltration of surface water into the profile;
- Subsurface inflows of infiltrated water from the surrounding dwarf shrublands; and
- A hydrological regime dominated by the capture of surface water, its brief retention and then the steady vertical and lateral drainage through the coarser layers of the profile.

Key ecological drivers of the Dambos are:

- Diffuse surface and sub-surface flow from the surrounding dwarf shrubland. Water enters the basin and does not necessarily drain out, but rather infiltrates the sand; and
- Rainfall.

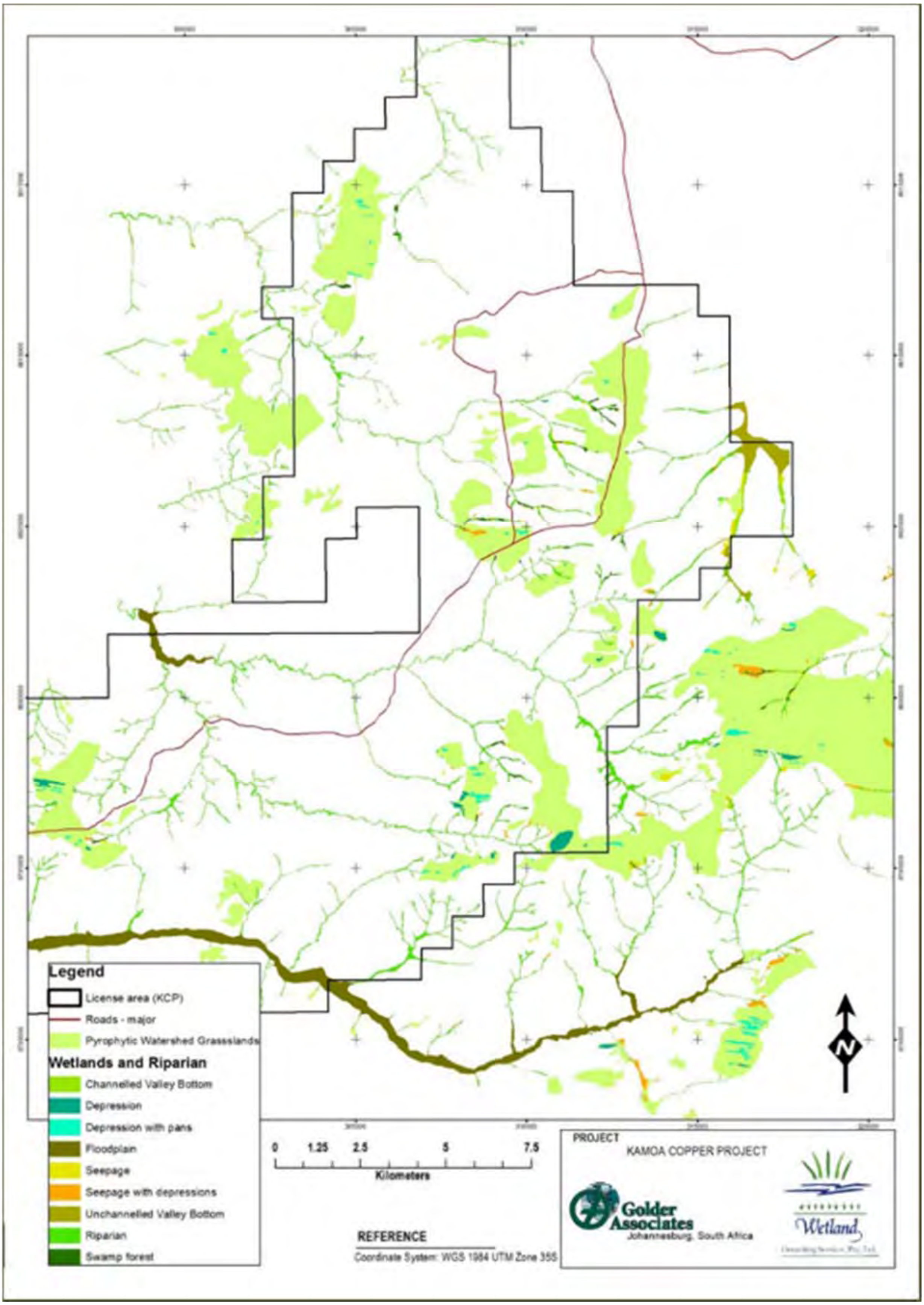


Figure 66: Distribution of Wetland and Riparian systems according to HGM units within the study area

Springs

Springs are typically associated with certain perennial rivers which arise from the Pyrophytic Dwarf Shrublands and are characterised by:

- Being located at the heads of permanent streams arising from the periphery of the dwarf shrublands;
- Permanent flow into small rock pools at the head of the streams; and
- Exposed bedrock either from a contact between different geologies or where a dyke or sill is exposed.

While surface runoff and subsurface seepage probably both contribute hydrologically to the streams in which the springs occur, by far the unique process characterising these systems is point source groundwater discharge. The groundwater clearly emanates from the Pyrophytic Dwarf Shrublands which are situated immediately upslope of the springs. These are likely to contribute substantially to the maintenance of perennial flow in the associated streams providing clean water to the landscape throughout the dry season.

Floodplain Wetlands

These systems are restricted to the southern portion of the study area and are not likely to be directly influenced by the proposed mining operations. They are characterised by:

- The presence of levees;
- Clear evidence of coarse alluvial sediment deposition (sediment fans); and
- Alternative flow paths and oxbow features.

The dominant driving process is overflow during peak longitudinal flows. The watersheds of these systems are also associated with the Pyrophytic Dwarf Shrublands although they are also fed by several smaller drainage systems which do not arise from the dwarf shrublands. These smaller, steeper drainages probably contribute to the sediment load during rainfall events, thereby maintaining the dynamism of the system, with the alternating cycles of sediment deposition and erosion continually alternating the position of the main channel. The supply of sediment is an important process because it ensures that the suspended sediment loads contained in longitudinal flow are high enough to reduce the erosive potential of the river, preventing channel incision and deactivation of the floodplains.

6.3.2 The existence of a sensitive environment within or near the perimeter

The following sensitive areas listed in annexure XII of the Mining Regulations occur within the project area:

- Article 3 (c): An area where threatened or protected animal and plant species may occur. Aardvarks were identified in the natural miombo forest (Figure 65);
- Article 3 (d): An area subject to erosion – refer to Figure 34; and
- Article 3 (f): A source of potable water – most rivers in the project area are sources of potable water (Figure 66).

6.3.2.1 Protected Areas

The Site does not occur within any known protected areas in DRC. A private game reserve (the Manika Game Reserve) is in the process of being established east of the concession boundary along the proposed road access.

7.0 CHAPTER IV: DESCRIPTION OF THE SOCIOLOGICAL ENVIRONMENT

7.1 COMPONENTS OF THE SOCIOLOGICAL ENVIRONMENT

The applicant for a right to exploit mines or permanent quarries describes the sociological environment of his project by:

(A) identifying the villages, communities, and dwellings within its perimeter and near its perimeter as well as their local chiefs and the local administrative authorities;

(B) determining the sources of income of these populations and estimating their annual income;

(C) assessing, among these populations, the percentage of illiterate persons, the percentage of sick persons, the nature of the diseases or epidemics and their access to medical care;

(D) identifying the nature and extent of the activities of these populations within or adjacent to the perimeter such as industry, agriculture, animal husbandry, harvesting, hunting, fishing, trapping etc.;

(E) determining road infrastructure and access roads within or around the perimeter; and

(F) determining whether its perimeter encroaches or is in the vicinity of one or more restricted areas as defined in section 2 of the Mining Regulations.

Information on villages and surrounding communities around the Kamoa Copper Project is provided at section 7.1.1.

As for sources of income in the study area, it is described at section 7.1.3.

Section 7.1.2 explains the political, administrative and customary structure around the Kamoa Copper Project area as required by Article 38 of the DRC Mining Regulations in Chapter IV of Annex IX of the Mining Regulations.

Education and health are sufficiently detailed at section 7.1.4.

Employment in the Kamoa Copper Project area has been the subject of a detailed study as described at section 7.1.5.2 in accordance with the mining regulations in force in the DRC.

The baseline social studies of the Kamoa project deals with the social context around the mining areas of Kansoko and Kakula as well as the new road from the airport up to Kolwezi.

Other social data collections were conducted in October and November 2016 through household surveys and focus groups.

This recent research was undertaken to update the previous survey data from 2013 as well as to focus on the current social situation within the Kakula footprint area and the Kolwezi road route.

For the purposes of this report, the above data provided a detailed picture of the Kamoa Project mine concession area and information updates were provided for the following communities, including areas around Kakula and Kolwezi airport road up to the mine.

The social baseline for the Kamoa project discusses the social context of the Kansoko and Kakula Mine areas as well as the new road to Kolwezi. Based on the already existing social baseline information and the limited timeframes associated with this EIS update, the baseline component is derived from secondary sources.

There was further social data collection undertaken in October and November 2016 through household surveys and focus group discussions. This recent research was undertaken to update the previous 2013 survey data as well as focus on the current social situation within the Kakula footprint area and New Kolwezi road alignment. For the purposes of this report, the previous data provided a detailed picture of the broader Kamoa Copper mine concession area and updated information has been sourced for the following communities associated with the Kakula footprint area and Kolwezi road:

- Muvunda (Kakula footprint area) – 11 household surveys (17% sample);
- Samukoko (Kakula footprint area) – 6 household surveys (22% sample) and one focus group discussion;
- Cite Maseka (Kakula footprint area) – 5 household surveys (16% sample) and one focus group discussion;
- Kamisanga (Kakula footprint area) – 9 household surveys (20% sample) and one focus group discussion;
- Manga Manga (Kolwezi road) – 10 household surveys (15% sample); and
- Musumpo (Kolwezi road) – 23 household surveys (3% sample).

The above survey data is still being captured and analysed however, information from the focus group discussions are aligned with the information presented in the baseline section below. The three communities of Samukoko, Cite Maseka and Kamisanga still maintain the social profile and characteristic from the previous studies.

The sociological environment has been determined using a literature review, analysis of Kamoa Copper SA census data, qualitative research, socio-economic household sample surveys and a household census survey. Collection of social data for a description of the regional baseline referred to in this section was undertaken between 2010 and 2013, and data sources are described below:

- Kamoa census data included the majority of villages within the mine license area and a number of surrounding villages;
- For the purposes of Golder qualitative baseline data collection in September 2012, the area of influence was defined on a regional level as Kolwezi District, and on a local level as villages of grouping chiefs and those within a 500 metre radius of proposed project infrastructure;
- The area of influence was revised in March 2013 and the local study area includes all villages within the mine license area, villages of the grouping chiefs, Mwilu and Musokantanda, and villages within 1km of the project infrastructure buffer zones; and
- Based on the need to commence with resettlement planning activities, a census survey and associated socio-economic sample survey was undertaken between June and October 2013 within the defined exclusion zone. This exclusion zone is based on the area which is expected to be affected by land take from the proposed project.

Currently (2016), resettlement hasn't occurred and the area of influence determined in 2013 has reduced to focus on the Kakula Mine and Kolwezi Road alignment.

Social features of ethnic groups within the Kamoa Project area

The territory of Mutshatsha is inhabited mainly by Ndembo and Sanga, with smaller ethnic groups of Lunda and Chokwe. For Mutshatsha, the City Council produces annual reports describing the ethnicity of the territory of the Ndembo, Chokwe, Kaonde, Sanga and Luba.

The table below summarizes some of the features of these ethnic groups in the Kamoa Copper Project area. It is the Chief who governs the tribe. The Chief presides over a court of officials, some of whom are called "notables." This court is responsible for the administration of the tribe.

The Chief of the land supports the Chief of the tribe on a spiritual and traditional level. The Chief of Land manages all the chiefs of the villages in the tribal grouping. Some villages also elect their own notables to represent key groups in the village community.

Modern religions are becoming more and more widespread in the Musokantanda and Mwilu grouping areas, where there are Catholic and Protestant communities as well as Methodist and Orthodox groups. The practice of traditional religions is insignificant. The Protestant religion is most predominant in the Kamoa Project footprint.

The most common ethnic group is the Ndembo, which accounts for 37% of the population, followed by Sanga, who represent 35%. The other major ethnic groups in the study area are the Lunda (8%) and the Chokwe (8%). Several other ethnic groups are poorly represented in the Project area (12%). The distribution of these ethnic groups can lead to land and property disputes between the Chiefs. About 87% of the inhabitants of the area are practicing Christians, the others being animists or atheists.

7.1.1 Villages, Communities and Dwellings

Villages within the project area are outlined in Table 48 and their geographical location is shown in Figure 67. Owing to the large number of villages and the variations in sample sizes between them, sampled villages were grouped into 12 Village Groups (VGs; Table 49) according to similar characteristics such as:

- Spatial location and connectivity to access/trading routes: Where villages are located within close proximity of each other and share common access/trading routes they were more likely to be grouped together;
- Sociocultural considerations: Villages from the two grouping chiefdoms are considered separate groupings;
- Size of village: Smaller villages/hamlets were combined in order to increase the reporting and analysis sample size; and
- Main economic/livelihood activities and/or sociocultural arrangements: Where villages clearly had differing economic activities/livelihoods and/or sociocultural arrangements, these villages were considered separate groupings.

The Project area is characterised by scattered, rural villages and hamlets divided between the two groupings of Mwilu and Musokantanda, amongst the oldest villages in the area. Figure 67 and Table 49 provide an overview of the villages included in the local study area, indicating the household census count undertaken by Kamoa in 2010/2011 (where applicable), and the 2013 household counts based on the RAP census surveys or the SIA SES (where applicable), and a brief description of the village's history and current status.

Table 47: Overview of economic and social settings in the Kamoa Project area

Ethnic Group	Political Structure	Controls of the Royal Lineage	Spiritual and Traditional Structure	Main economic activities	Main Cultures	Main domestic animals	Comments
Ndembo	King or chief of the tribe Officials of the Court Notable	Death of the matrimonial mother A group of his sons constitute leadership	Head of land Head of village Healers Devins				Predominant ethnic groups
Chokwe		Matrilineal Lineage					
Kaonde	Chief of the tribe Notable		Territorial Representatives Head of land Healers Devins				Ethnic minority group
Basanga	Chief of tribe Tribe	Matrilineal with a tendency to bilinearity Heirs chosen from brothers, nephews, grandchildren or matrilineal sons by the Council of Elders	Lutungu Healers Devins				Ethnic minority group Highly superstitious
Key: economic activities	- Hunt - Cultures - Forging of copper – Meetings – Extraction of copper and salt - Trade - Fishing - Animal husbandry - Forging / Sculpture						
Key: crops	- Maize - Cassava - Sorghum - Millet - Sweeet potatoes - Peanut - Pumpkin - Beans - Yam - Tobacco – Squash – Palm tree raffia - Voandzou / Bambara peas						
Key: animals	- Dogs - Poultry - Sheep - Pigs - Goats						

Table 48: Villages in Project area with chiefdom and household counts

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Benkeni	Mw	23	33[2]		Benkeni was established in 1982 by a family from Sanka who moved in search of better cultivation land following operations of Gecamines. The family were wary of spirits in the new village and so initially returned to Sanka, only completing the move in 1985 following a number of ceremonies undertaken by elders of Sanka.
Chamadingi (Tshamadingi)	Mw	13	20[2]		Chamadingi was established in 1969 by families from Mupenda who moved to avoid reduced water- and air quality thought to have been caused by Gecamines. The settlement has decreased in size as many younger families have moved to Katayi in search of employment opportunities. The village has a number of unoccupied and collapsed structures illustrating its former size.
Chindechinde	Mus	-	21[2]		Chindechinde was described as the name of a family who now live in Katayi. Residents of the village referred to as Chindechinde belong to the Mausonge and Katok families who moved to the area in 2009 from Kolwezi in search of land. The family explained that they often return to Kolwezi during the dry season although did not do so in 2012. The settlement is small and surrounded by cassava fields. Structures appear temporary, made from wood and plastic rather than mud or brick walls.
Cite Maseka	Mus	-	20[3]	31	Cite Maseka lies along the road to Musokantanda in close proximity to Samukoko. Although many residents have lived in the village for over 20 years, the village appears less established than others in the area.
Cite Musoka (Dipuma)	Mus	222	175[2]		Cite Musoka previously comprised a number of smaller hamlets and settlements on the border of the Mwilu and Musokantanda grouping boundary. Households began moving into the area in 2003 from many different areas in search of land, however, Chief Musokantanda decided to unite the villages into one to avoid disputes and move households away from the KAMOA COPPER SA camp. The village is now a large settlement with many new structures and some in the process of being built.
Ferme Kaponda	Mus	-	11[2]		Ferme Kaponda is a small settlement of retired soldiers and their families who have been settled by government.
Israel	Mus	86	115[2]		Israel was established in 1957 by Christian households in search of agricultural land. Originally only 4 households lived in the village, but the village has grown considerably as households move in search of land. The village was also described as a location for households moving in search of employment opportunities. In the last year, 5 households were thought to have moved into Israel.

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Kabulo	Mus	-	7[2]		The hamlet of Kabulo has reportedly been abandoned by residents. However, residents in Mawawa indicated still using the graveyard.
Kakisa	Mw	-	17[2]		The current chief of Kakisa is the 3rd chief in the village, however, he is not related to the Kakisa family. All residents living under the first 2 Kakisa chiefs relocated to Zambia during the war. Current residents all moved in under the new chief chosen by Mwilu in the last 50 years.
Kakunta	Mw	50	56[2]		Kakunta was established in 1984 with residents moving from Mwilu in search of new land.
Kaloko	Mw	12	33[2]		The village of Kaloko, also referred to as Mobuto, lies on the road from the camp to Kolwezi. The village is relatively small with temporary structures observed. No detailed information was obtained on the history of the village.
Kalundu	Mw	-	5[2]		Kalunda is a small, remote settlement in the north of the project area, established at least 30 years ago.
Kamakala	Mw	-	4[2]		Kamakala is a small hamlet to the east of the project area established by the daughter of the chief of Kakunta.
Kamisange	Mus	-	50[3]	45	Kamisange is an established, peaceful village on the road to Musokantanda. Many residents were born in the village, however, a number of households have moved into the village in the last 5 years in search of land and employment.
Kamoa Mission	Mw	50	38[2]		Kamoa Mission was established in 1993 by a family from Mpala who moved in search of farming land. In 1995 more families moved to the village from Kolwezi for the proximity to the church and fields.
Kangaso	Mw	-	16[2]		No detailed information was obtained on Kangaso, however, the village is similar to Paulo, Chamadingi and Wiri; established in the 1950s and having decreased in size as households move to Kolwezi or Katayi.
Kaponda 1	Mus	43	52		Kaponda was established in 1958 by Chief Kaponda Lugwe who moved to the area in search of agricultural land. Households moved from the village of Kabungi on the road to Mushima. Homesteads were established on either side of the river, however, the chief wanted them to remain as one village, hence the naming of Kaponda 1 and Kaponda 2. Many households have moved to Kolwezi for health and educational services, however, the village has also grown through natural population growth and households moving in search of land.
Kaponda 2	Mus	24	19[2]		

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Kavuma	Mus	-	25[3]		Kavuma is a relatively established village along the road to Musokantanda. The majority of household residents were born in the village, although some have moved in the last 5 years, suggesting a recent influx and population growth.
Kaya	Mw	-	16[2]		Kaya was established in 1982, on land apparently bought from the French. The headman claims a title deed exists and the village falls outside of traditional chiefdom authorities. Although the land was initially purchased for farming only, a small village has been established and households apparently pool resources.
Londorino	Mus	15	24[2]		Londorino is not recognized by local chiefs as separate village but it is integral part of Mundjendje village.
Mangi Basin	Mus		117[2]		The Mangi Basin features a number of hamlets and villages located on apparently fertile land.
Mawawa	Mus	3	15[2]		Mawawa was established in 2003 by a family moving from Kolwezi to cultivate land. The village still has connections to Kolwezi and some return for work, however, the family cultivates a relatively large area of land.
Mukanga	Mus		19[2]		Mukanga is located near Chindechinde.
Mulemena	Mus		85[3]		Mulemena is a relatively large village located along the road to Musokantanda. The village is one of the older settlements in the area, with the majority of residents born in the village. However, some households have moved into the village in the last 5 years in search of land.
Mundjendje	Mus	25	37[2]		Mundjendje was established in the 1950s by Chef Mundjendje Ilunga. The first chief moved from Mupenda, originally leaving to begin mining activities, but disputes in Mupenda led him to establish a new village. The village has increased in size with natural population growth, however, some new households have moved into the village since 2000.
Mupenda 1 & 2	Mw	35	45[2]		Mupenda was established in 1950 when the Mupenda family moved in search of agricultural land. The current chief is the 4th in line. Previously a hamlet, Mupenda has attracted households from further afield in search of land and work, growing to village size over the years.
Musokantanda	Mus	-	224[3]		Musokantanda is one of the two groupings in the project area. The current chief of Musokantanda is the 21st in line. In 1954 the Belgians established the current village of Musokantanda, constructing a school and clinic. Surrounding families living in small hamlets moved into the village to utilise these services. Other families then moved from Kolwezi, Mutshatsha, Mwilu and Zambia, 45 km away. Musokantanda is now a large village with school, clinic, police station and village hall. The Belgian influence is apparent in the remaining structures along the main road.

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Musulu	Mw	-	5[2]		Musulu was established in 1984 at the same time as the village of Kakunta, approximately 500m away. Although Musulu has its own chief, the village is described as a quarter of Kakunta, falling under the rule of the Kakunta chief.
Muvunda	Mus	-	80[3]	62	Muvunda is one of the two land chiefs in the project area. The current chief of Muvunda, the chef de terre, came to power in 1968, moving closer to the Basanga people and a school, approximately 300 m away from the previous location. The Muvunda chiefs and family have been established in this area for many years, longer than living relatives can remember. The village has grown over the years as households move in search of fields to cultivate. In the last year, 5 new households moved into the village, from Kolwezi and other areas.
Mwilu	Mw	-	115[3]		Mwilu is one of the two groupings in the project area. The current chief of Mwilu is the 26th chief to take charge of the village and grouping. The family originally moved to the area for agricultural land. Households moved over the years in search of mining and other agricultural opportunities, however, the current village of Mwilu was firmly established when the Belgians came to the area in the early 1950s. Mwilu is a well-established village with strong traditional authority.
Ndjoni	Mw	4	10[2]		No detailed information was obtained on Ndjoni, however, the village is similar to Paulo, Chamadingi and Wiri. Ndjoni was established in the 1950s and is now relatively run down with many empty structures as households have moved to Kolwezi or Katayi.
Ndjosayi (Djosayi)	Mw		22[2]		No detailed information was obtained of Ndjosayi. The village is located near Cite Musoka.
Paulo	Mw	18	22[2]		Paulo was established in the 1950s by Chef Ngonzo Paulo who moved from Cite Albert in Kolwezi. Village representatives explained that they were displaced by Gecamines operations and moved to the area for the quality of land and proximity to the river. Many households have now left Paulo and returned to Kolwezi in search of educational facilities, meaning the village is now relatively small.

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Placide/Katayi (Mukanga)	Mus	22	94[2]		Placide was founded in 1998 by a family from Ndjoni searching for cultivation opportunities. In 2002, Chief Katayi joined the area, moving from Chamadingi due to a dispute in the village. Although two separate villages were originally founded, they now function as one given the large influx of households from Kolwezi and surrounding villages. A large proportion of structures are built from plastic and temporary materials, and many households indicated moving to the village for business, retaining a homestead in Kolwezi. The villages of Placide and Katayi were formally known as Mukanga.
Postolo/Sapalo	Mw		24[2]		Postolo/Sapalo is located near the villages of Kamoa mission, Tshiwisha and Benkeni.
Quatre Jours (Muzeya)	Mus	17	25[2]		Quatre Jours is a relatively small village in close proximity to Cite Musoka. No detailed information was obtained on the village.
Samukoko	Mus	-	20[3]	27	Samukoko is a small settlement located along the road to Musokantanda in close proximity to Cite Maseka. The majority of residents moved to the village from Kolwezi in the last 15 years.
Sanka 1	Mw	-	60[3]		Sanka 1 was established in 1964 and is a relatively large settlement in the north of the project area.
Sanka 2	Mw	-	4[3]		The location of Sanka 2 village was debated by residents of Walemba and Sanka 1. The surveyed settlement lies between Sanka 1 and Walemba village near the railway station and is also referred to as Kamukonzo. Further reference was made to a separate village of Sanka 2 to the west of Mwilu.
Sapatelo	Mw		20[2]		Sapatelo is located close to Tshiwisha.
Tshimbundji	Mus	-	9[2]		Tshimbundji is a small settlement along the road to Musokantanda. The village was established in 1995 by a household moving from Mupenda. They were joined by a household from Mulemena and another from Zambia in the last 10 years.
Tshiwisha	Mw	8	10[2]		Tshiwisha was established in 1984 by one family who moved to the area to farm. Upon the death of the chief, the family returned to Ngonzo near Kolwezi, returning in 1995. Since then, the village has grown with 7 new households moving into the village in the last year. The current chief claims to have purchased the land and be in possession of a title deed.
Venance	Mus	3	22[2]		Venance was established in 2000 by a family living in Twana, approximately 30 minutes' walk from Venance. The extended family wanted to establish a farm and was allocated approximately 25 ha by Chef Muvunda.

Village	Group*	2011 Household Count[1]	2013 Household Count	2016 Household Count	Description of History
Walemba	Mw	256	370[3]		Walemba is a large, established village spanning 3 km in length along a road and rail line. The village continues to grow given the presence of schools and hospital. Households move from smaller villages and from Kolwezi in search of services and land.
Wiri	Mw	9	17[2]		Wiri was established by Chief Wiri Kiombe in 1950, replaced by the second and current chief, Kalenga Mupanga. The village has decreased in size over the years as households have moved to Kolwezi in search of educational facilities. Wiri is a small, quiet village largely inhabited by an older generation.

*Mw = Mwilu, Mus = Musokantanda;

1 - 2010/2011 KAMOA COPPER SA census counts; 2 - 2013 RAP census counts; 3 - 2013 SIA SES extrapolation

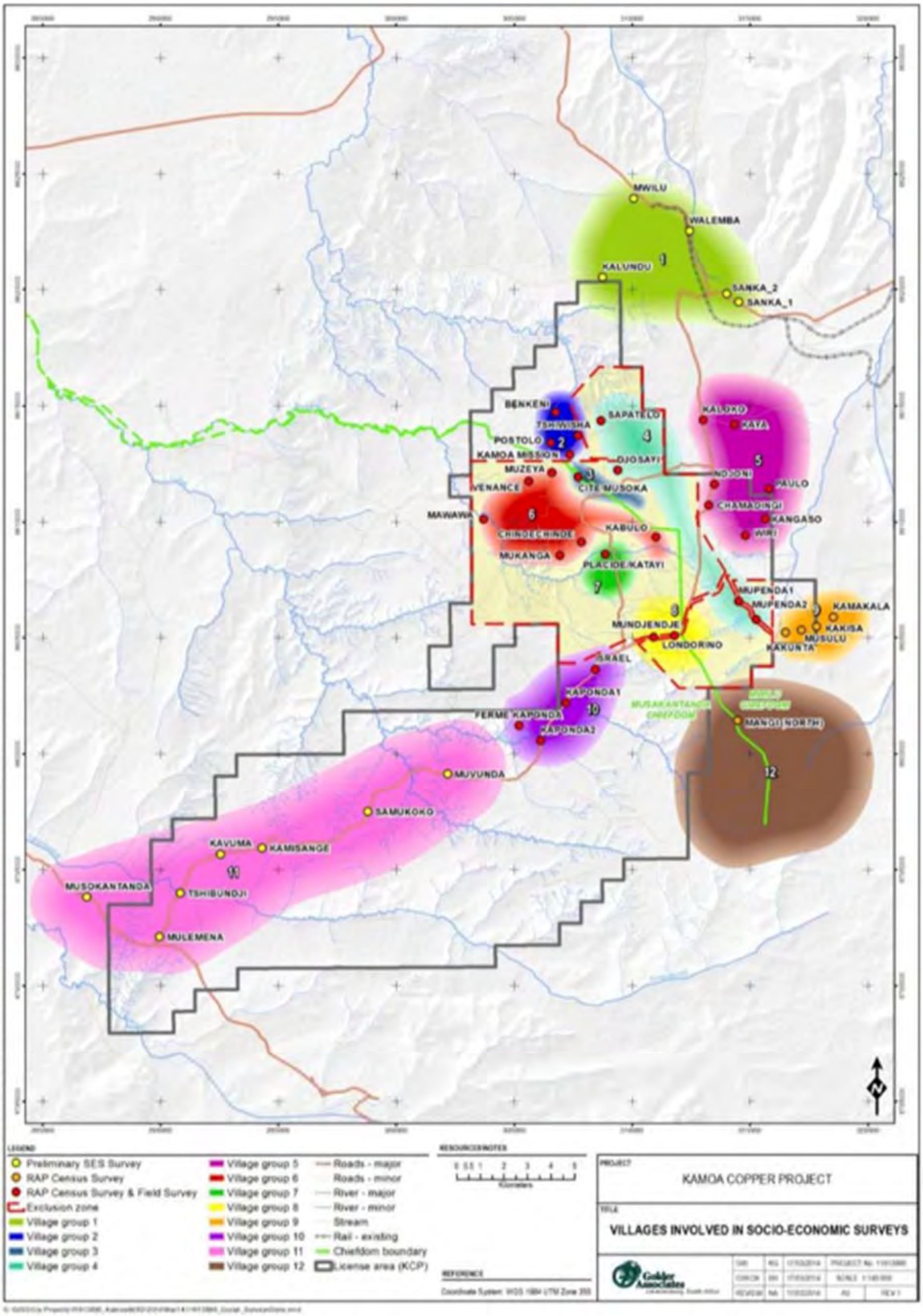


Figure 67: Location of villages and structures

Table 49: Villages within the project area and relevant grouping

Village Group	1	2	3	4	5	6	7	8	9	10	11	12
Village names	Kalundu	Benkeni	Cite Musoka	Mupenda 1	Kaloko	Venance	Placide	Londorino	Musulu	Israel	Musokantanda	Mangi area
	Mwilu	Tshiwisha	-	Mupenda 2	Kaya	Muzeya	Katayi	Mundjendje	Kavuma	Kaponda 1	Mulemena	-
	Sanka 1	Kamoa Mission	-	Djosayi	Ndjoni	Chinde-Chinde	-	-	Kakisa	Kaponda 2	Tshibundji	-
	Sanka 2	Postolo	-	Postolo/ Sapetelo	Paulo	Mukanga	-	-	Kamakala	Ferme Kaponda	Kavuma	-
	Walemba	-	-	-	Chamadingi	Mawawa	-	-	Kakunta	-	Kamisange	-
	-	-	-	-	Kangaso	Kabulo	-	-	-	-	Samukoko	-
	-	-	-	-	Wiri	-	-	-	-	-	Muvunda	-
Total villages	5	4	1	4	7	6	2	2	5	4	7	1
Data source	SIA SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	RAP Census and SES	SIA SES	RAP Census and SES

7.1.2 Administration and Governance

The project is located in the Lualaba Province in the south east of the DRC ruled by Governor of Province, his Excellency Richard Muyej Mangez Mans and Mrs the vice Governor, Her excellency Fifi Masuka(with provincial government. Originally named Shaba, the province was re-named Katanga in 1997 before being subdivided in February 2009 under the new constitution, leading to the creation of four new provinces: Haut-Katanga, Tanganyika, Lualaba and Haut-Lomami.

Each province has a provincial parliament (with provincial parliament) and a number of districts responsible for administrative matters. The Provincial parliament of Lualaba is lead by his Excellency Louis Kamwenyi Thumbu.

Kolwezi is main town of Lualabla Province, head of Provincial offices is headquarter of Kolwezi mayor's office ruled by Mrs Veronique Upite Kamin.

Government representation is then found at Territory and Sector level. The Kamoa Copper project is located Mutshatsha Territory ruled by Mr Felicien Misanu Mponyo and across Lulua and Lufupa sectors lead by Mr Gustave Kamamba and Mr Roger Kasongo.

Below sector level, administrative matters are handled by traditional governing systems; each sector consists of a number of Groupings led by chiefs responsible for managing individual village chiefs operating at a grassroots levels. Village chiefs are responsible for settling disputes and maintaining peace and harmony in the village, although some matters may be deferred to the Grouping Chief for resolution.

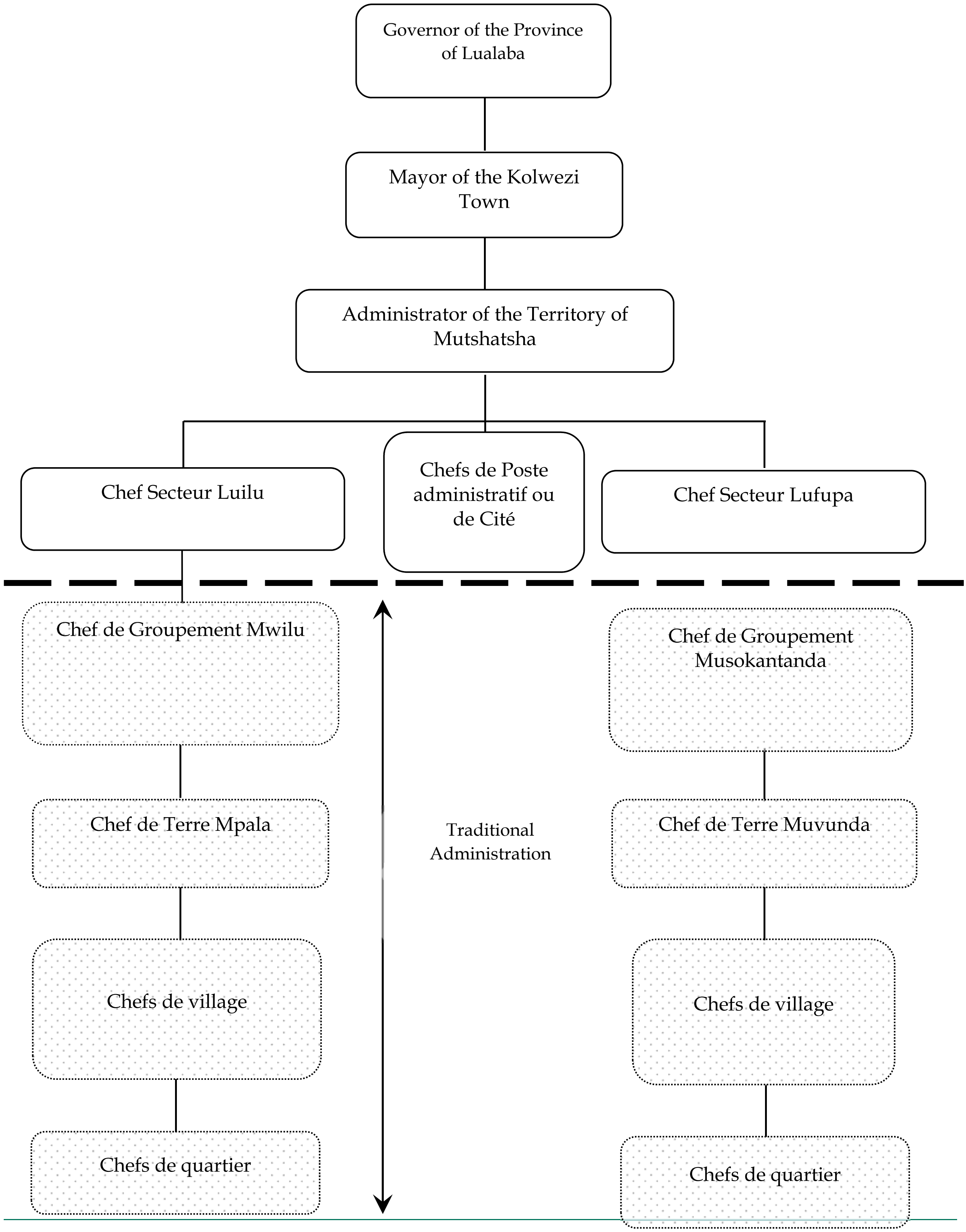
Each Grouping also has a *chef de terre*, "chief of the land", often considered to be the intermediary between humans, the land and the spirits or ancestors to whom it belongs. The *chef de terre* is considered the owner of all land, and is responsible for distributing land portions to communities and households and for performing the ceremonies to maintain the equilibrium between men and ancestors. Two Groupings are included in the concession area for the Project, Mwilu and Musokantanda, with *chef de terre* of Mpala and Muvunda respectively.

Kamoa Copper Project is located between Musokantanda and Mwilu grouping areas lead by Mr Henri Kafweku Musokantanda and Mr Mwilu Kashiki Bulungo and is across lands ruled by Muvunda and Mpala chiefs.

Below are the table and figure that represent the political and admistrative structures within the Kamoa Copper Project area.

Table 50: Political and Administrative framework

Project	Province	Territory	Sector	Grouping	Land
Kamoa Copper Project	Lualaba	Mutshatsha	Lufupa	Musokantanda	Muvunda
			Luilu	Mwilu	Mpala


Governor of the Province of Lualaba
Mayor of the Kolwezi Town
Administrator of the Territory of Mutshatsha
Chef Secteur Luilu
Chefs de Poste administratif ou de Cité
Chef Secteur Lufupa
Chef de Groupement Mwilu
Chef de Groupement Musokantanda
Chef de Terre Mpala
Traditional Administration
Chef de Terre Muvunda
Chefs de village
Chefs de village
Chefs de quartier
Chefs de quartier

7.1.3 Revenue sources

Kolwezi Town serves as the primary transportation centre and market place for the region. Kolwezi District is economically dependent on the mining sector, specifically focusing on the extraction of copper, cobalt and zinc. Kolwezi town itself was founded in 1900 when exploration activities began in the area. Mining organisations currently in operation in the district include GCM, KCC, CHEMAF, SOMIKA, KAMOA COPPER SA, KATANGA METALS and TFM. There are also limited industrial activities in operation in the province, including construction and civil engineering, SNCC transport, electricity (SNEL) and water (REGIDESO) organisations and hydroelectric operations. The agricultural sector provides employment and a livelihood base to a large proportion of the population in Kolwezi District, including limited commercial agricultural, but primarily subsistence agriculture, however, economic contributions from this sector are likely to be far lower than the mining sector.

Within Kolwezi town, mining activities appear to be on the increase, with five internationally listed mining companies and several private medium-scale currently operating or establishing operations in Kolwezi – along with several other large internationally listed companies exploring operations in Kolwezi. Amongst these are Metorex, KCC, Sicamines and the remaining Gecamines mines. This is expected to provide a substantial boost to the economy of Kolwezi town but will also attract opportunity seekers.

Artisanal mining is a significant livelihood activity both in Kolwezi and national – nationally representing (with their dependents) an estimated 15 to 20% of the national population, and the artisanal miners produce 90% of the DRC's minerals whilst only 10% is produced by large scale mines. According to Pact (DRC) (2012), artisanal mining activities has been fuelled by rising international copper prices and a weal local administration unable to enforce mining legislation and susceptible to corruption. As concessions are provided to large-scale mining companies, artisanal miners have increasingly come under pressure and has result in (often violent) confrontations between artisanal miners, public security forces and mining company employees.

Pact (DRC) (2012) reported that Kolwezi has an estimated population of 600,000 people of whom roughly 4,000 are expatriates working primarily in the mining sector and its related supply services. With an estimated 30,000 artisanal miners operating illegally in the Kolwezi area, this sector of the population presents a major opportunity for, or constraint against, economic recovery. Several thousand women and 4,000 children are directly involved in or indirectly affected by artisanal mining in the town and district of Kolwezi.

7.1.3.1 Income

Income types and average amounts earned by different village groups in the project area are outlined in Table 51. The average annual household income is $4,416 in the project area which varies between village groups. Based on all surveyed households, men earn 74% of the average monthly household income (AMHI), while women and children respectively earned 24% and 2%. The highest proportions of men earning the AMHI were recorded in Village Groups 6 (Venance, Muzeya, Chindechinde, Mukanga), 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) (ranging from 80% to 85%). Correspondingly, these village groups had the lowest proportions of women earning AMHI, ranging from 15% to 18%.

Table 51: Average Income (US$) for local study area

Type of income	Monthly	Annual	Highest per Village Group (per month)	Lowest per Village Group (per month)
Average household income	$368	$4,416	Village Groups 9 and 12 ($486 and $762 respectively	Village Groups 2 and 6 ($271 and $291 respectively
Average formal income	$29	$348	Village Group 3 ($58)	Village Groups 2, 6, 9 and 10 ($0 to $9)
Average casual income	$5	$60	Village Group 7 ($27)	Village Groups 2, 6, 9 and 10 (ranging from $0 to $1).

Type of income	Monthly	Annual	Highest per Village Group (per month)	Lowest per Village Group (per month)
Average home enterprise/business income	$56	$672	Village Groups 1 and 3 ($85 and $132 respectively)	Village Groups 5, 6, 8 and 9 (ranging from $11 to $17).
Average income from charcoal	$105	$1,260	Village Groups 9, 10 and 12 (ranging from $210 to $244)	Village Groups 6, 7 and 11 (ranging from $31 to $52).
Average income from crops	$160	$1,920	Village Groups 9 and 12 ($224 and $488 respectively)	Village Groups 2, 8, and 10 (ranging from $74 and $87).
'Other' income sources	$13	$156	-	-

The lowest proportions of men earning the AMHI were recorded in Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) and 12 (Mangi area) (55% and 54% respectively). Correspondingly, these village groups had the highest proportions of women earning AMHI (44% and 46% respectively). The highest proportions of children earning the AMHI were recorded in Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba), 3 (Cite Musoka) and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) (4% each). No children earned an AMHI for Village Groups 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 7 (Placide, Katayi), 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) and 12 (Mangi area). The average income per person per day is shown in Table 52, based on the household income and the average number of persons per household. The average household income per person per day was approximately US$2.40. The highest average incomes were recorded in Village Group 7 (Placide, Katayi) and 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) (approximately US$2.95) and the lowest proportions were in Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) (approximately US$1.95).

Table 52: Average income ($US) per person per day

Village Group	1	2	3	4	5	6	7	8	9	10	11	12	Far	Total
$US/person /day	1.97	2.50	2.48	2.46	2.78	2.46	2.94	2.27	2.96	2.35	1.87	2.27	2.55	2.42

Source: Socio-economic survey and Census survey (2013).

It should be noted that income levels are often estimated by survey respondents as no official records are kept and sales of crops or charcoal are irregular and dependent on agricultural seasons and household expenditure needs.

7.1.3.2 Summary of income and employment trends

Based on the above discussions regarding income, employment, the following provides a summary for each village (relative to the other Village Groups):

- Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) generally has average levels of employment and income, except in the case of a high representation of income derived from small business. Some households from this Village Group own pumping equipment. The project is likely to have a negligible impact on this village group, provided that the sources of income are maintained;
- Village Group 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) generally has a low level of income, with some of the lowest amounts of average monthly income and income derived from cropping and formal employment. The income share for women is high relative to other villages, possibly as a result of women having one of the highest representations of employment for charcoal production and men

having one of the lowest representations of employment from charcoal production, in comparison to other Village Groups. Women in this village group have one of the highest representations for running small businesses and for farming. Children also have one of the highest representations for farming. The project is likely to have a negligible impact on this village group, provided that the sources of income are maintained;

- Village Group 3 (Cite Musoka) generally has average levels of employment and income, except in the case of a high level of income derived from formal income and small business. Accordingly, employment through small business is high for men and women. Given that this village group is within the Exclusion Zone, the impact of resettlement is likely to be low to moderate - on the condition that the income sources are compensated or improved, particularly in regard to fields, formal employment and small businesses;
- Village Group 4 (Mupenda 1, Mupenda 2, Djosayi, Sapatelo) generally has average levels of employment and income, except in the case of a low level of farming-derived employment for men. Given that this village group is within the Exclusion Zone, the impact of resettlement is likely to be low - on the condition that the income sources are compensated or improved;
- Village Group 5 (Kaloko, Kaya, Ndjoni, Paulo, Chamadingi, Kangaso, Wiri) generally has average levels of employment and income, except in the case of a low level of income derived from small business. Some households from this village group own pumping equipment. The project is likely to have a negligible impact on this village group - provided that the sources of income are maintained;
- Village Group 6 (Venance, Muzeya, Chindechinde, Mukanga, Mawawa) generally has low level of income, with some of the lowest amounts of income derived from casual employment and small businesses. However, this village group has some of the highest levels of income derived from formal employment and charcoal production. The income share for men is high relative to other villages, possibly as a result of the high dependence on charcoal production, which is a business dominated by men. There is a high dependence of employment through farming, for both men and women. This dependence on subsistence farming may explain why income levels are generally low. Given that this village group is within the Exclusion Zone, the impact of resettlement is likely to be low - on the condition that the income sources are compensated or improved, particularly in regard to fields and charcoal production;
- Village Group 7 (Placide, Katayi) generally has average levels of income, although income derived from casual employment and charcoal production is relatively high. For men, employment through small businesses is relatively high, while employment through farming is relatively low. There is some income derived from renting land or fields. Given that this village group is within the Exclusion Zone, the impact of resettlement is likely to be low to moderate - on the condition that the income sources are compensated or improved, particularly in regard to small businesses, casual employment and charcoal production;
- Village Group 8 (Londorino, Mundjendje) generally has average levels of general income, although income derived from small business and farming is relatively low. For men, employment through farming is relatively low, while formal employment is relatively high. There is some income derived from renting land or fields. Given that this village group is within the Exclusion Zone, the impact of resettlement is likely to be low - on the condition that the income sources are compensated or improved, particularly in regard to formal employment;
- Village Group 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) generally has high levels of income derived from formal employment, small businesses, charcoal production and farming. For men and women, employment through charcoal production is relatively high. For men, formal employment is relatively low. There is some income derived from renting land or fields. The project is likely to have a low impact on this village group - provided that there sources of income are maintained;
- Village Group 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) generally has average levels of income, although income derived from formal employment and charcoal production is relatively high. There are low amounts of income derived from casual employment and farming. Men have a high share of the income in this village group, possibly because men have one of the highest representations of

employment derived from charcoal production, which is a business dominated by men. The project is likely to have a low impact on this village group - provided that the sources of income are maintained or replaced (in the case of fields inside the Exclusion Zone);

- Village Group 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) generally has average levels of income, except in the case of high levels of income derived from charcoal production. The share of income for women is relatively high. Men have one of the highest representations of employment through farming, while women have one of the lowest for farming. Men have one of the lowest representations of employment derived from charcoal production. Some households from this village group own pumping equipment. The project is likely to have a negligible impact on this village group - provided that the sources of income are maintained; and

Village Group 12 (Mangi area) generally has high levels of income, based on high levels of income derived from charcoal production and farming. Women have a high representation of income generation. Employment for men is relatively high for charcoal production and farming. Employment for women is relatively high for farming, and formal employment is low for men. There is some income derived from renting land or fields. The project is likely to have a negligible impact on this Village Group - provided that the sources of income are maintained.

7.1.4 Literacy and health

7.1.4.1 Education

Education facilities in the project area are extremely limited; primary schools within the project area are located in Musokantanda, Mupenda, Muvunda, Israel and Walemba. Secondary facilities are located in Musokantanda and Walemba (Figure 69). Given the distance of the remaining villages from these schools, many children are unable to attend school. The distance to and quality of available facilities also means many children attend school in Kolwezi, spending week days or term time in town with friends or relatives, and returning to villages at weekends or school holidays. According to the SIA SES, this is particularly common in the villages of Chamadingi and Kamakala where 18% of household members are described as students living elsewhere, and in Ndjoni where 11% are students elsewhere. The most common level of education attained across the surveyed population is some years of primary education (42%), followed by some years of secondary education (10%). A large percentage (21%) of the surveyed population is below school age and 19% have stated that they have no education. Higher education is uncommon, with less than 1% of the population attaining this level of education. A quarter (25%) of the local population has not attended school (Table 53) and for the child / adolescent category (5 to 19 years), 34% are not attending school. A relatively high proportion of elderly (over 60 years) have not attended school. Only 2% of the population have had some form of higher education beyond some years of secondary school.

Table 53: Education level by age category

	Infants (0 to 4 years)	**Children / Adolescents (5 to 19 years)**	**Young adults (20 to 39 years)**	**Middle aged adults (40 to 59 years)**	**Elderly (over 60 years)**	**Total**
None	12%	34%	20%	21%	43%	25%
Attending/attended school	2%	66%	76%	74%	53%	57%
Had/having some form of higher education	0%	0%	4%	5%	4%	2%
Too young for school	86%	0%	0%	0%	0%	16%
Total	100%	100%	100%	100%	100%	100%

Table 54 indicates that 61% of children aged between 5 and 14 years currently attend school, whilst 39% do not attend school. Few children continue their education beyond a few years of primary school.

Table 54: Attendance at school for children between 5 and 14

Level of education	No school	Some years of primary school	Primary certificate	Some years of secondary school	Total
Proportion (%)	39	58	1	2	100

Although education levels are low in the project area, households do have members with skills training or work experience in certain areas. Some surveyed households reported that at least one household member has work experience in masonry (27%), security duties (23%), carpentry (18%), driving (12%) and mechanical tasks (12%). According to the SIA SES, although no gender divide in school attendance was noted in the survey population aged 5-14 years, differences become more pronounced when considering the education levels for males and females aged 15 years and above (Figure 68). For population aged between 15 and 45 years, figures for no education are two or three times higher amongst females than males. Almost half of females aged 45 – 64 years have no education and 84% of females over the age of 65 have no education. Figures for males with no education remain between 10% - 15% across all age categories, dropping to only 2% for those aged 45 – 54 years, potentially reflective of periods with stronger facilities and services during colonial times.

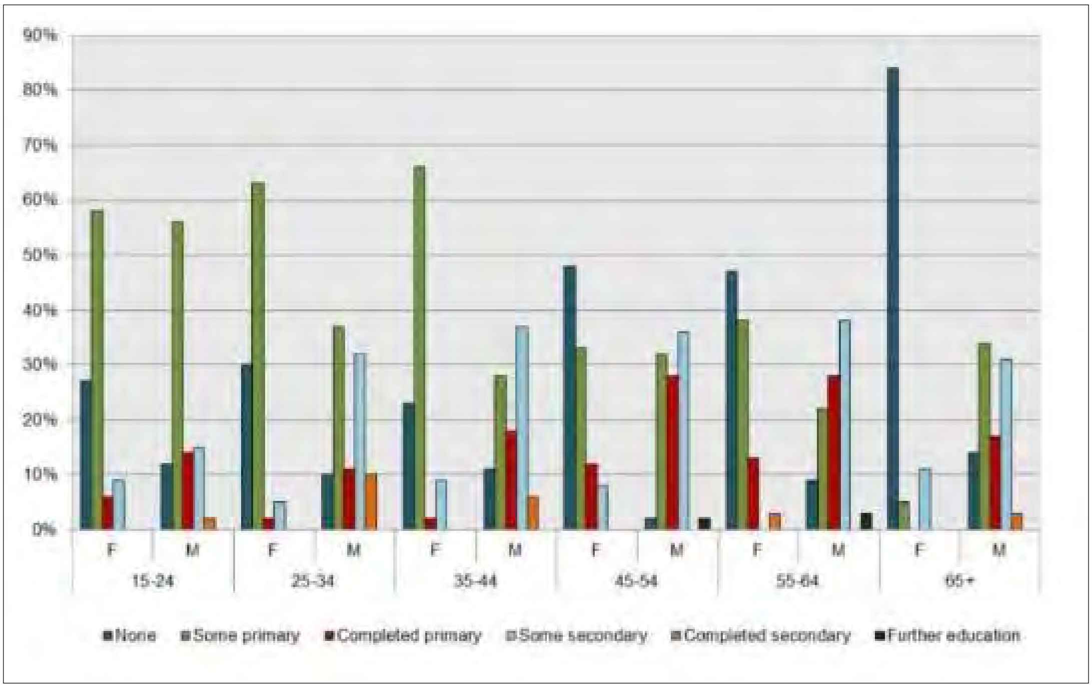


Figure 68: Education Levels for Male and Female Population Aged 15+ Years

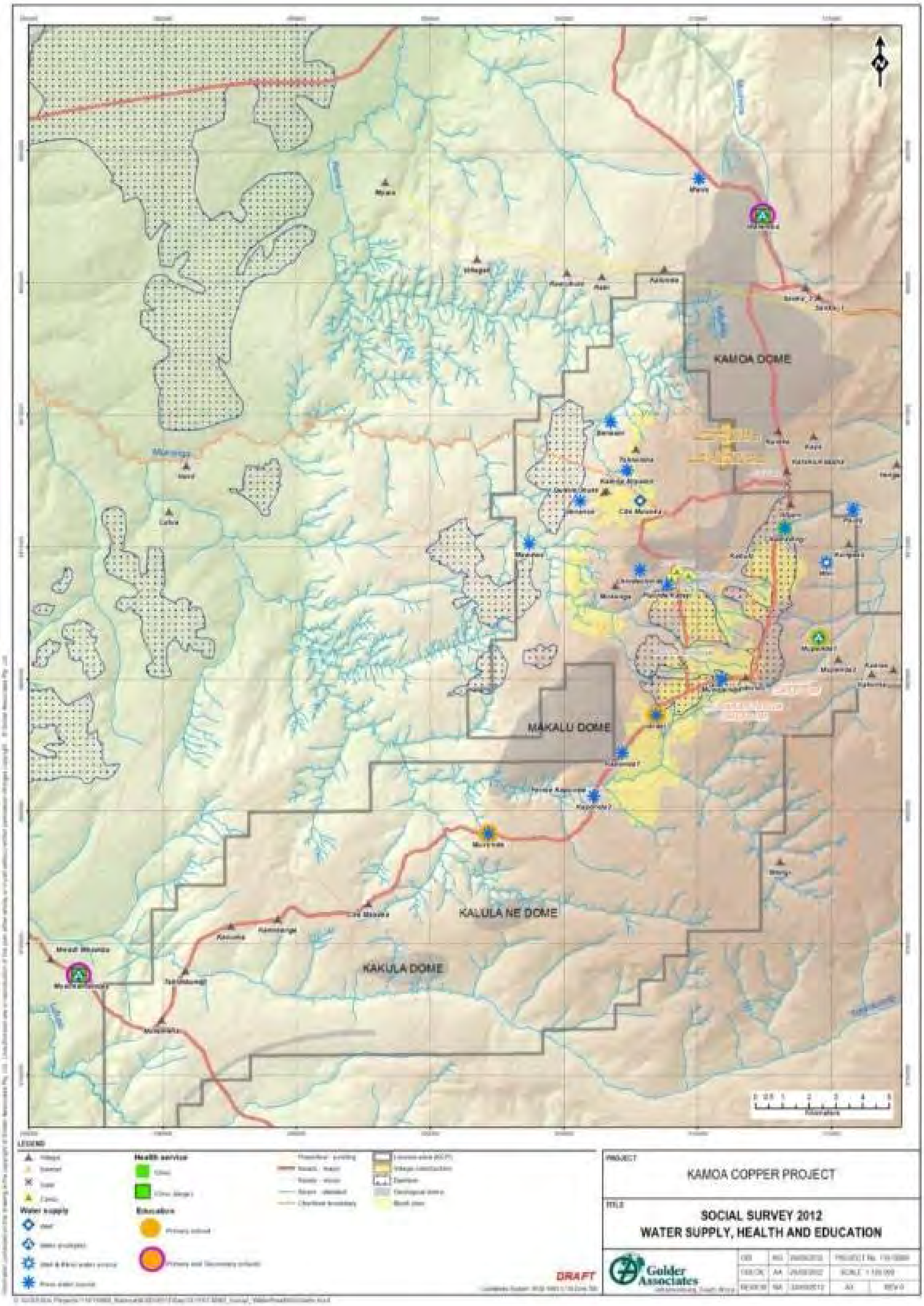


Figure 69: Social Infrastructure in the Project Area

7.1.4.2 Health

Health facilities in the project area are extremely limited. The project falls within the Kanzenze Health Zone, an area covering 11,302km² and serving approximately 94,439 people according to health survey results of 2010 – 2011. Officially, 15 health centres operate within the zone, including a general referral hospital at Kanzenze, and a hospital at Walemba. However, many of these facilities have little or no supplies or qualified staff. Nurses are available at each health centre, although many do not have formal qualifications, and 4 doctors cover the entire zone. Of these, 2 are based at Walemba along with 6 nurses. KAMOA COPPER SA has supported the development of Walemba hospital which now has an operating theatre, x-ray machine, and maternity clinic. Aside from Walemba, health services within the project area can be found at Chamadingi, Muvunda and Musokantanda (Figure 70). Residents therefore need to walk considerable distance to access basic health care services and expressed concern about the lack of facilities available.

Figure 70: Clinic at Walemba constructed by KAMOA COPPER SA

Medical services are heavily stretched for resources, given that half (50%) of the surveyed households had a household member hospitalised (stay in a clinic overnight) in the last 12 months. Village Group 8 (Londorino, Mundjendje) had 75% of households with a household member hospitalised in the last 12 months. Approximately a third (34%) of the surveyed households had a household too ill to work in the last 12 months.

For those with medical facilities in the village, this is the first method of treatment for most illnesses. However, for those further away from facilities, the first method of treatment is with traditional medicines. Only if traditional remedies do not work do households walk or cycle to medical facilities. Focus group participants also indicated purchasing medical supplies in Kolwezi and self-medicating in villages when necessary.

7.1.4.2.1 Deaths in households

Reports of deaths in households are high in the local study area, owing to limited medical facilities, low levels of knowledge about personal health and poor levels of nutrition. Approximately 10% of the surveyed households had a child member of the household die in the last 12 months. Village Groups 5 (Kaloko, Kaya, Ndjoni, Paulo, Chamadingi, Kangaso, Wiri) and 8 (Londorino, Mundjendje) had the highest proportions (21% and 17% respectively) of households with a child member dying in the last 12 months. Most of the child deaths related to very young children, as 9% of the surveyed households had a child member under the age of 5 years die in the last 12 months. Approximately 12% of the surveyed households had an adult member of the household die in the last 12 months. Village Group 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) had the highest proportion (33%) of households where a household member died in the last 12 months, compared to only 2% of households in the adjoining Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba).

7.1.4.2.2 Food shortages

Of surveyed households, 19% reported a household member going without a meal the day before being surveyed. Village Group 8 (Londorino, Mundjendje) had 42% of households reporting a household member going without a meal the day before being surveyed, while no-one at Village Group 2 (Benkeni, Tshiwisha,

Kamoa Mission, Postolo) went without a meal the day being surveyed.

Over half (57%) of the surveyed households reported a food shortage in the last 12 months. Food shortages were least prevalent in Village Group 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda), where 23% of households reported food shortages.

7.1.4.2.3 Pregnancies

At the time the survey, 15% of households reported a single pregnancy of a household member at the time of the survey. No household reported more than a single pregnancy. Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) had 27% of households reporting a pregnancy of a household member, in comparison to no reported pregnancies for Village Group 7 (Placide, Katayi).

7.1.4.2.4 Disease and ailments

The most common reported illness in the project area is malaria. The medical records at the Walemba clinic confirm this finding. Participants described malaria as an almost continuous illness, explaining that there are new cases almost every day. However, given the lack of diagnosis equipment and individual funding for such tests, many treat a variety of symptoms as malaria. The official rate of malaria is therefore expected to be lower than the levels indicated through the household surveys. A malaria campaign was implemented in July 2012 across the zone distributing mosquito nets to households. The scheme aimed to provide each household with one mosquito net, or two for households with children. It is too early to estimate the impact of these nets. However, some families explained that they have only one net but many children, and that only adults slept under the net.

In light of the above, 71% of the surveyed households self-reported suffering from malaria in the last 12 months. Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 5 (Kaloko, Kaya, Ndjoni, Paulo, Chamadingi, Kangaso, Wiri), 6 (Venance, Muzeya, Chindechinde, Mukanga, Mawawa) and 8 (Londorino, Mundjendje) had proportions of household affected by malaria that were equal to or exceeded 80%. Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) and 12 (Mangi area) had the lowest self-reported proportions of household affected by malaria, with 54% and 62% respectively. The average number of people suffering from malaria across all households was 1.3 persons (with an average household size of 5.1). Village Group 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) had the highest average number of people affected by malaria per household (1.9 persons), while Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 3 (Cite Musoka) and 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) had the lowest number of people affected per household (1.0 persons for all three Village Groups).

Surveyed households also self-reported the following ailments in the past 12 months:

- Skin conditions were reported by 27% of the surveyed households. Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) had the highest proportion (42%) of households affected by skin conditions, while Village Groups 8 (Londorino, Mundjendje), 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) had the lowest proportions (ranging from 8% to 10%);
- Diarrhoea was reported by 42% of the surveyed households. Village Groups 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo) and 8 (Londorino, Mundjendje) had the highest proportions of households affected by diarrhoea, with 65% and 67% respectively. Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) had the lowest proportions of households affected by diarrhoea, with 20% and 23% respectively;
- Severe coughs were reported by 85% of the surveyed households suffered from a severe cough in the last 12 months. Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) had the highest proportion (98%) of households affected by cough, while Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) had the lowest proportion (60%) of households affected by cough; and
- Fever in the last 12 months was reported by 75% of the surveyed households. Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) had the highest proportion (90%) of households affected by cough, while Village Groups 6 (Venance, Muzeya, Chindechinde, Mukanga), 7 (Placide, Katayi), 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) had the lowest proportion of households affected by cough (ranging from 54% to 60%).

While there was some awareness of the HIV/AIDS, understanding of the seriousness of the risks of the disease appear to be limited. Most focus group participants did not consider HIV/AIDS to be a problem in their village, however, some explained that they had seen cases in Walemba, and focus group participants in Walemba confirmed this, connecting the illness to prostitution which they saw as a problem. Some also explained that there were no testing facilities available which meant many did not know if they had the illness, adding to the lack of awareness around HIV/AIDS.

Of surveyed households, 15% did not know how to prevent the spread of HIV/AIDS, with the highest proportions occurring in Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) (34% and 29% respectively). Village Groups 5 (Kaloko, Kaya, Ndjoni, Paulo, Chamadingi, Kangaso, Wiri), 6 (Venance, Muzeya, Chindechinde, Mukanga), 7 (Placide, Katayi), 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) also had a number of households unaware of the prevention of HIV/AIDS, ranging between 5% and 12% of households. All households in Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 3 (Cite Musoka), 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 8 (Londorino, Mundjendje) and 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) were aware of methods for preventing the spread of HIV/AIDS.

About 93% of surveyed households have received some information regarding the prevention of HIV/AIDS - 27% obtained information from radio, 20% obtained information through word-of-mouth, and 21% obtained information through a combination of radio and word-of-mouth. Village Group 3 (Cite Musoka) and 8 (Londorino, Mundjendje) had high proportions of households that obtained information through radio (49% and 50% respectively). Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) had high proportions of households that relied on word-of-mouth for information (35% and 29% respectively). These two village groups also had the highest proportions of households that did not receive any information (13% and 18% respectively).

Abstinence and/or having sex with one partner was reported as the best method(s) for preventing the spread of HIV/AIDS by 59% of surveyed households. About 16% of surveyed households indicated multiple methods to prevent the spread of HIV/AIDS. Only 7% of surveyed households indicated that the use of condoms (single response only) was the best method/s for preventing the spread of HIV/AIDS. Village Group 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) and 7 (Placide, Katayi) had the highest proportions (17%) of households giving this single response, while no households in Village Groups 8 (Londorino, Mundjendje) and 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) had this single response.

For those households with medical facilities in the village, such facilities are the first method of treatment for most illnesses. However, for those further away from facilities, the first method of treatment is with traditional medicines. Only if traditional remedies do not work do households walk or cycle to medical facilities. Focus group participants also indicated purchasing medical supplies in Kolwezi and self-medicating in villages when necessary.

7.1.4.2.5 Health summary

Village Group 8 (Londorino, Mundjendje) appears to be the most vulnerable community regarding illness, childhood deaths and food shortages. Malaria, coughs and fever are most prevalent in the study area. Village Group 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) has the highest proportions of households suffering from coughs, fever and skin conditions (although it has the lowest proportion of malaria for any Village Group). Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) generally have the lowest proportions of malaria, skin conditions, diarrhoea, coughs and fever.

7.1.5 Livelihood Strategies

Livelihoods are primarily dependent on subsistence farming and charcoal burning, supplemented by limited formal and informal employment.

7.1.5.1 Subsistence farming and charcoal burning

Of the surveyed households involved in subsistence farming in the past 12 months, 54% of men, 52% of women and 3% of children are primarily involved in subsistence agriculture. For men, Village Groups 6 (Venance, Muzeya, Chindechinde, Mukanga), 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) and 12 (Mangi area) have the highest proportions (ranging from 69 to 76%), while Village Groups 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 7 (Placide, Katayi) and 8 (Londorino, Mundjendje) have the lowest proportions (ranging from 29% to 33%). For women, Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 6 (Venance, Muzeya, Chindechinde, Mukanga, Mawawa) and 12 (Mangi area) have the highest proportions (ranging from 83% to 88%) while Village Group 11 has the lowest proportion (28%). For children, Village Group 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) has the highest proportion (8%), while Village Groups 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 6 (Venance, Muzeya, Chindechinde, Mukanga), 7 (Placide, Katayi), 8 (Londorino, Mundjendje), 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda), 12 (Mangi area) had no children working with crops or livestock. No migrants were involved in subsistence farming in the past 12 months, except for Village Group 9 (Musulu, Kavuma, Kakisa, Kamakala, and Kakunta) where 5% of households employed migrant workers for farming activities.

Of the surveyed households involved in charcoal production in the past 12 months, 54% of men, 7% of women, and 2% of children are primarily involved in charcoal production. For men, Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala), 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) and 12 (Mangi area) have the highest proportions (70% of Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) and 88% of Village Group 12), while Village Groups 2 and 11 (Musokantanda, Mulemena, Tshibundji, Kavuma, Kamisange, Samukoko, Muvunda) have the lowest proportions (ranging from 30 to 33%). For women, Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) and 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) have the highest proportions (17% and 15% respectively) while Village Group 7 (Placide, Katayi) has the lowest proportion (0%). For children, Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 3 (Cite Musoka), 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 6 (Venance, Muzeya, Chindechinde, Mukanga), 8 (Londorino, Mundjendje), 10 (Israel, Kaponda 1, Kaponda 2, Ferme Kaponda) and 12 (Mangi area) employed no children. No migrants were involved in charcoal production in the past 12 months.

7.1.5.2 Other forms of employment

Formal employment opportunities are very low in the local study area. Only 10% of surveyed households have had formal employment in the past 12 months. Only 3% of surveyed households had been employed by KAMOA COPPER SA, with a further 3% being employed by contractors of KAMOA COPPER SA.

Village Group 8 had the highest proportion (25%) of households with formal employment, while Village Groups 9 (Musulu, Kavuma, Kakisa, Kamakala, Kakunta) and 12 (Mangi area) had the lowest proportions (0% and 4% respectively). Men dominate formal employment opportunities, with 9% of surveyed households reporting that men were employed. Women were only formally employed in Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, Walemba) and 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), with 1% and 8% respectively. Some children were employed in Village Group 3 (2% of the village group households). No migrant workers had formal employment.

Only 4% of surveyed households have had casual employment in the past 12 months. Men were the only people with casual employment. There was no casual employment for Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 4 (Mupenda 1, Mupenda 2, Djosayi, Sapetelo), 8 (Londorino, Mundjendje) and 12 (Mangi area).

Overall, 25% of households reported owning a small business, with the highest proportions of households in Village Groups 1 (Kalundu, Mwilu, Sanka 1, Sanka 2, and Walemba) and 7 (43% and 33% respectively). Small businesses are predominantly run from home on a daily basis, often as a tailor, traditional healer or running a kiosk. Focus group participants in Placide/Katayi explained that many in the village run various business selling soft drinks, beers, and groceries, whilst participants in Walemba pointed to artisanal mining as a secondary source of income, with males travelling towards Kolwezi to undertake such activities.

Of the surveyed households involved in home enterprises or small businesses in the past 12 months, 12% of men are employed, 24% of women are employed, and 1% of children are employed. For men, Village Groups 3 (Cite Musoka) and 7 (Placide, Katayi) have the highest proportions (23% and 25% respectively), while there are no men employed in home/business enterprises in Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo), 6 (Venance, Muzeya, Chindechinde, Mukanga, Mawawa) and 8 (Londorino, Mundjendje). For women, Village Groups 2 (Benkeni, Tshiwisha, Kamoa Mission, Postolo) and 3 (Cite

Musoka) have the highest proportions (23% and 25% respectively). For children, Village Groups 3 and 8 have the highest proportions (4% and 8% respectively). No migrants were involved in home enterprises or small businesses in the past 12 months.

Focus group participants in Placide / Katayi explained that many in the village run various business selling soft drinks, beers, and groceries, whilst participants in Walemba pointed to artisanal mining as a secondary source of income, with males travelling towards Kolwezi to undertake such activities.

7.1.6 Road infrastructure and pathways

Road infrastructure and pathway routes are illustrated in Figure 2. The closest major township in the project area is Kolwezi which can be accessed via regular flights from Lubumbashi (~45 minutes). Kolwezi is connected by road to Likasi and Lubumbashi and travel time by car is ~4-5 hours. The route is a combination of tarred and gravel roads, which have recently been refurbished and are in reasonable condition. The road network throughout the Project area has been upgraded by Ivanhoe Mines and access from Kolwezi is via unsealed Kolwezi – Angola Road to the villages of Kasekelesa and Musokantanda. Movement within the project area is typically along this road and comprises buses and 4x4 vehicles, some farm traffic (private vehicles), bicycles (utilised by charcoal producers), and pedestrians. The presence of vehicles within the project area is extremely limited and the majority of the population utilise unmarked tracks and paths between the roads to access water, cultivation and charcoal areas.

Typically half of local communities' access roads to go to schools an hour away, while people typically walk to fetch water and cycle to markets. Fields and churches are close to local villages and typically take under an hour to access. Medical services in Walemba, Chamadingi, and Musokantanda are most often visited by foot. Two thirds of people living in the project area typically don't travel for formal work, given the current lack of employment opportunities

7.1.7 Restricted areas

Restricted areas relate to any portion of national territory for the purposes of mining that is:

- Reserved for a cemetery;
- Containing archaeological remains or a national monument;
- Near Army infrastructure;
- Part of, inter alia, an airport;
- Reserved for a nursery of forest trees or for forests;
- Situated:
  - < 90m from the outskirts of a village, township, municipality, or city
  - < 90m from a dam or building belonging to the state; and
  - In a national park.
- A Street, road, or highway including other portions of land referred to in section 279 of the mining code[3].

No mining activity is planned within restricted areas. Outside of villages, restricted areas potentially associated with the project are outlined below.

Archaeological and Cultural Heritage Surveys

Archaeological and cultural heritage surveys were conducted in the Project Area in 2010, 2012 and 2013 as part of the original Environmental Impact Study (EIS) and subsequent update and more recently from 24 October to 2 November 2016 specifically covering the Kakula mine area and proposed road access route.

[3] Provided under *ad hoc* relevant legislation.

Archaeological Findings

Archaeological potential is poor or low throughout the surveyed area.

To define whether the sites where of any value the following criteria was utilised. None of the sites conformed to any of the criteria below and therefore are deemed of low importance.

1. **State of preservation of the site**
   - Is the site well preserved
2. **Spatial arrangements**
   - Does the site exhibit useful information about housing or village spatial arrangements?
3 **Features of the site**
   - Are there any unusual, unique or rare artefacts or images at the site?
   - Is it a type site?
   - Does the site have a very good example of a specific time period, feature, or artefact?

4 **Research**
   - Does the site provide information useful for current research projects?
   - Does the site provide opportunities to salvage information for potential future research projects?

5 **Inter- and intra-site variability**
   - Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?
   - Can this particular site yield information about a community's social relationships within itself, or between other communities?
6. **Educational**
   - Does the site have the potential to be used as an educational instrument?
   - Does the site have the potential to become a tourist attraction?

Cultural Heritage

Interviews were conducted by the team at Musokantanda, Muvunda, Kakula, Kamisangi, Musompo on the 25, 27 and 27 October 2016 with the local community leaders his royal highness Musokantanda, Muvunda chief of land assisted by their notables as local guide and local community members. With their permission the team was taken to their sacred sites. From the interviews held the following information was obtained. The Project is grateful to the local chiefs and communities for allowing the team access to sacred areas.

Cemeteries

The overwhelming majority of cemeteries are located between Musokantanda and Israel (Figure 71).

Cemeteries are divided into the following main types;

1) Public cemetery;

2) Twins (as they are considered to be pure and clean);

3) Cemetery for children; and

4) Cemetery for still born children. .

Those that commit suicide are dumped into rivers and "forgotten about by the community". Unexplained deaths (or death due to unknown illness) can result in communities moving away from an area abruptly leaving behind the dead (termite mounds can result from "evacuated settlements" and are therefore a potential sign of habitation).

Sacred, Cultural, and Ceremonial Places

The following sacred, cultural and ceremonial places where identified by local communities in the Project area;

- Rivers and waterfalls – these are considered sacred and when visiting Chiefs or sacred areas a gift is normally required. A series of waterfalls and cascades are located on the Lufupa River and are considered sacred. These are Tshituta 1, Tshituta 2:, Tshituta 3 and Lufuba - located in the

Musokantanda chiefdom, the largest waterfall (Lufuba) of is considered a sacred place, the other falls are used as ceremonial places;

- Muyombo (Sacred trees) are located at Musokantanda, Muvunda and Mwilu villages – they are planted by the community when a new chief is appointed during the dry season and not watered (if they survive then the Chief is accepted).
- Springs - At Musokantanda and at Mwilu it was mentioned springs are classified as sacred. Unfortunately it was not possible for the team to visit those places.
- Cultural / ceremonial places include a sacred hut at Mwilu village made of adobe bricks covered with straw.

Historical Context

There is very little information about the history of two chiefdoms. The data indicates that people from Musokantanda (the Kaonde ethnic group) are originally from Zambia. As for Mwilu, they belong to the Basanga ethnic group.

The exact origin of each of these two ethnic groups is not known with precision. The two ethnic groups are matrilineal and both are farmers and blacksmiths.

There are three main tribal groups in the area:

- Sanga (indigenous - Chief Mwilus tribe);
- Ndembo; and
- Kaonde (migrants from Zambia who were given land by the Sanga tribe in the late 1800's – Chief Musokantanda);

At the request of the Mayor of Kolwezi, the potential for ethnic conflict was investigated. The conflict potential regards the historical dynamic between Chief Mwilu and Musokantanda. Chief Mwilus ancestors granted land to Musokantanda who migrated from Zambia to escape persecution, and were therefore "guests" of the Sanga. The evidence to support this is from oral history and the fact that Chief Mwilu has a pendant issued by the Belgians which shows that his is a recognised traditional position. Musokantanda does not have this showing that the Musokantanda Chiefdom was not established as a traditional authority when the Belgians arrived in the early 1900's. Intermixing between the tribes means that conflict is unlikely, and there is no precedent for this in the local area.

However it is an aspect that should be monitored discreetly, with regular meetings and equal respect / opportunities given to both the chiefdoms.

Beliefs and Traditional Practices

Cultural practices have been affected in contemporary times by various movements of people, in and out prior to mining activities, and modernisation. Local communities do not hold onto to their traditional practices illustrated by the fact that initiation ceremonies are very rarely undertaken and traditional languages are seldom spoken, the most spoken language is Swahili. The ancestral belief system is an important aspect of local culture. For example 1 August is "the day of the dead" or Remembrance Day, local people use this day to visit the cemeteries; graveyards to remember grieve and or celebrate the memory of those lost.

As for the spirituality and morality, basically, local communities (Kaonde's and Basangas) believe in a supreme being or God and all spiritual beings made of pure and spiritualized human minds. God is more feared than loved, one does not speak directly to him, and this justifies the permanent use of spirit as intercessors to God. This aspect is particularly evident in the worship of spirits and religious practices (rituals).

Key aspects noted relating to local custom and culture include the following:

- If the chief slaps you before you separate from him you must also slap him back all over his body, otherwise, if you do not do this, misfortune will accompany you throughout your life.

- A grouping chief is not allowed to eat in public places or in front of people because if he drops any portions of the food, these maybe collected and used by his enemies against him.
- A chief's wife during her menstrual cannot cook for him nor sleep with him, nor stay with him in the same plot until the menstrual period ends. Menstruation is considered not pure and thus neutralizes a chief's power.
- It is always advised when a chief stands up, everyone must also stand up, otherwise if you are seated, and you will automatically become impotent. In front of the chief, you cannot cross your legs which is an offence and seen as disrespectful to him.
- Before speaking to the chief, one should clap gently hands which is sign to be authorized to speak and for a women she has to kneel down and must not look at the chief whilst speaking to the chief.
- In local culture, a boy's initiation differs from the girls'. When a girl sees her first menstrual cycle, she will immediately contact her mother and both should then live away from the father for about 6 days. The mother or daughter is not allowed during this period to cook for her husband or father.
- A boys' initiation takes a year, far from their village, these initiations are undertaken by special people in the village away from the father and mother, the boy's training period consists of the following:
  - Circumcision;
  - Teaching inclusive of:
    - Introduction to married life;
    - Good manners;
    - Introduction to working life; and
    - Values and principles of life, of traditional and cultural practices seen as cultural heritage left by ancestors.
- Once a man has completed two to three months training away from their parents, he is considered ready to marry, may choose a woman and then boy's parents are the ones to contact girl's parents asking for marriage, proper traditional ceremonies to be done.
- It is considered by local people that when following these principles, people are living closely to ancestors' need and standards.

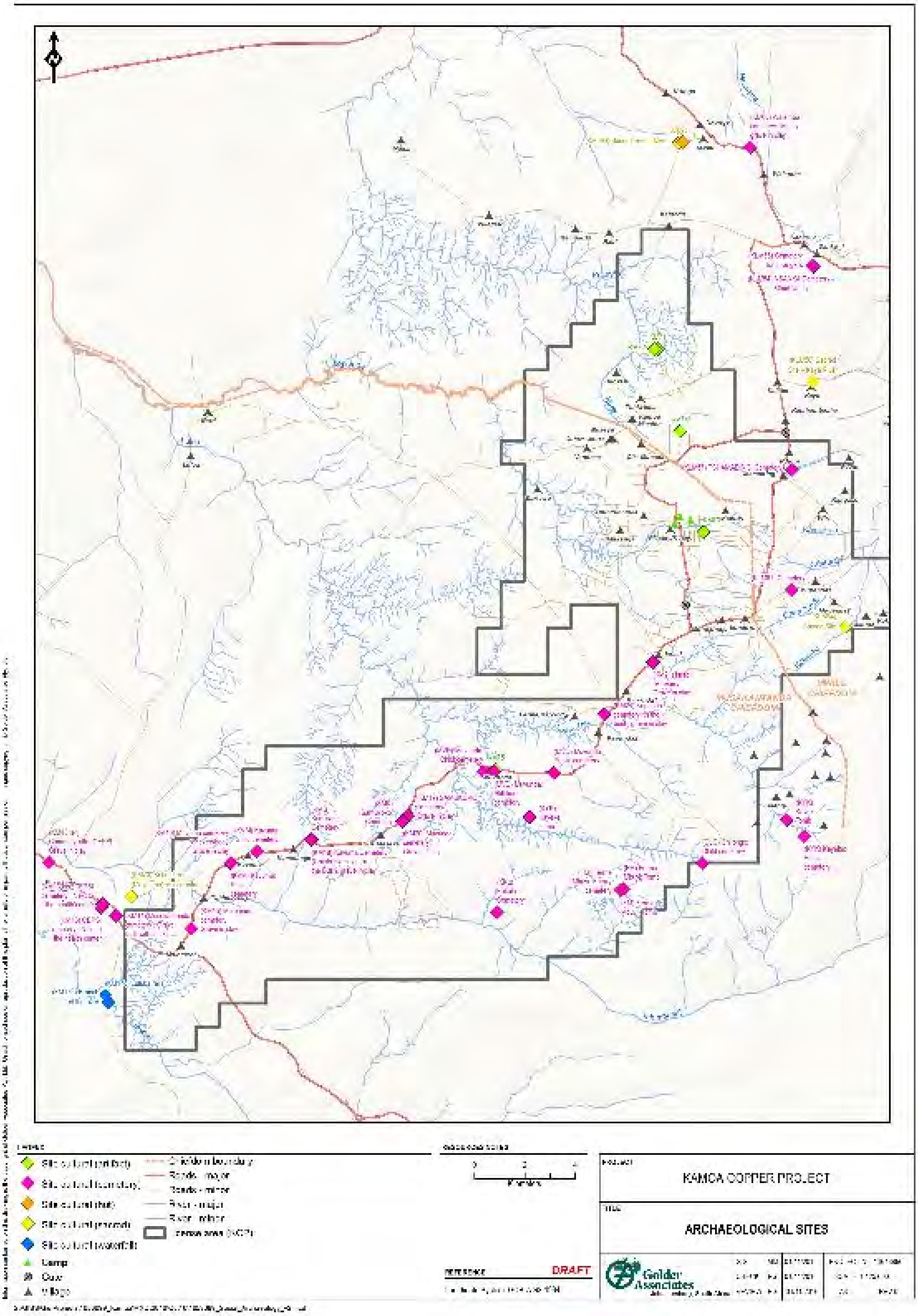


Figure 71: Archaeological and Cultural Heritage Sites

TITLE IV: ANALYSIS OF THE IMPACT OF THE EXPLOITATION OPERATIONS ON THE ENVIRONMENT

8.0 CHAPTER I: ANALYSIS OF THE IMPACT OF THE EXPLOITATION OPERATIONS ON THE ENVIRONMENT

8.1 Current Environmental Liability

Since 2012 after the approval of the original EIS (AMC, 2012), Kamoa has continued with exploration work (drilling and development of access roads) and began the development of the Kansoko Decline in December 2015. No further physical disturbances have been made on the concession area apart from some expansion to the employee camp. Currently the Kansko decline has caused the followng impacts, which are limted to the footprint of the decline area (2km^2)

- Clearance of land foir the portal and waste rock dump resulting in some soil loss althought topsoil has been stockpiled for future use;
- Impacts on vegetation due to land clearance;
- Erosion and sediment runoff from the Waste Rock Dump into the adjacent Dilungu;
- Some disruption to surface water runoff and flow;
- Discharge of water pumped from underground operations – dirty water from operations are contained within a settlement pond prior to release with water quality monitoring indicating compliance with DRC Effluent quality guidleines;
- Dust due to construction work, and drilling;
- Noise and vibration from blasting and ventilation;
- Visual impacts due to topographical changes;
- Some impact to groundwater from dewatering however as the decline has not extended more than 60m the impact on groundwater availaibility is limitied and no evidence of acid rock drainage has been identified;
- Displacement of field for an area of 7km^2 at Kansoko. This area was surveyed in 2016 and compensation made to individuals and communities for loss of crops, fields and access to this land. No physical resettlement is required for the Kansoko mine and no grave sites were identified inside the planned perimeter fence.

Drilling and continued exploration has resulted in:

- Land clearance for road access and drill pads;
- Some small incidents of soil contamination due to spills;
- Dust from exposed areas, excavation, drilling and traffic as well as vehicle tail pipe emissions;
- Soil erosion due to clearance of land fro drilling and establishment of roads particularly in the Dilungus which results in erosion.
- Some noise and vibration from traffic and construction equipment can cause annoyance to the people in sensitive receptors; and
- No significant trace of impacts on surface and groundwater have been identified through ongoing environmental monitoring.

Mitigation measures as per the previuos EIS as well as management measures for exploration are in place and are ongoing at Kamoa. These above impacts have been taken into consideration in the updated assessment evaluated in the following chapter which assess the larger project development which is planned to commence in 2017.

8.2 Features of Impact

The overall process and methodology being followed for the EIS update is based on the requirements of the DRC mining Code (specifically Decree No 038/2003 of 26 March 2003 of the Mining Code).

The EIS is based on a systematic and objective assessment of likely environmental, social and health effects of the Project, whether negative or positive. The impact assessment uses the baseline data and the likely interactions between the Project, the environment and people. Direct, indirect and cumulative impacts will be identified with the appropriate mitigation measures.

In accordance with the compliance criteria, an assessment of direct, indirect and cumulative impacts and identification of applicable mitigation measures, including compensation, will be prepared. The assessment of impacts will be issue focused, and based on likely interactions between the Project and the environment.

There are five primary steps to impact analysis:

1) Identification of Project activities that could contribute to environmental, social and health change.
2) Evaluation of potential negative and positive impacts.
3) Description of mitigation measures to avoid, reduce, restore or compensate for negative impacts and enhance positive impacts.
4) Analysis and characterisation of residual impacts and if the residual impacts are acceptable.
5) Recommendation of monitoring measures and indicators to track the project environmental, social and health performance.

8.2.1 Methodology for Assessing Impacts

The significance of the impacts identified during the impact assessment phase will be determined using the approach outlined below. This approach is based on the requirements of the DRC mining code.

8.2.2 Impact Assessment Matrix

To assess impacts an Impact Assessment Matrix has been used which provides a quantitative indication of the severity of an impact prior to and following mitigation. The matrix is based on the requirements outlined by the DRC mining code and is as follows.

Table 55: Impact Assessment Matrix

Direction	Intensity	Extent	Duration	Value of affected component	Risk to the human population	Probability
Positive – impact is positive or beneficial to the environment	5 - Very high/don't know	5 - International	5 - Permanent	5 - Very high/don't know	5 - Very high/don't know	5 - Definite/don't know
	4 - High	4 - National	4 - Long-term	4 - High	4 - High	4 - Highly probable
Negative – impact is negative or causes adverse damage to the environment	3 - Moderate	3 - Regional	3 - Medium-term (8 - 15 years)	3 - Moderate	3 - Moderate	3 - Medium probability
	2 - Low	2 - Local	2 - Short-term (0 - 5 years) (impact ceases after the operational life of the activity)	2 - Low	2 - Low	2 - Low probability
	1 - Minor	1 - Site only	1 – Immediate	1 - Minor	1 - Minor	1 - Improbable

Once these factors are ranked for each impact, the significance of impact is defined using the following formula:

- **SP (significance points) = (Average of Intensity, Extent, Duration, Value of affected component and Risk to the human population) * (Probability)**

The maximum value is 25 significance points (SP). The impact significance was then rated as follows:

SP >20	Indicates **Severe** environmental significance/risk	An impact which could influence the decision about whether or not to proceed with the Project regardless of any possible mitigation.
SP 16 – 20	Indicates a **major** environmental significance/risk	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP 9 - 16	Indicates **moderate** environmental significance/risk	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP 4 - 9	Indicates **low** environmental significance/risk	Impacts with little effect and which can be mitigated easily and would be easily absorbed by the environment or human population.
SP <4	Indicates a negligible impact/risk	Impacts with little real effect and which should not have an influence on or require modification of the Project design.

Impacts are re-rated following mitigation to determine residual impacts.

Definitions

For the methodology outlined above the following definitions were used:

- **Intensity** is a measure of the degree of change in a measurement or analysis (e.g. the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- **Extent** (**Scale/Geographic)** refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- **Duration** refers to the length of time over which an environmental impact may occur: i.e. transient (less than 1 year), short-term (0 to 5 years), medium term (5 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the Project), or permanent;
- **Value of affected component (Sensitivity)** is a measure of the uniqueness and value of the potentially affected component (i.e. regionally unique habitats. For other disciplines, the assimilative capacity of the physical environment to absorb / dilute contamination will be defined to determine sensitivity;
- **Human Value/Risk –** is a measure of the value of an affected component to local communities, and/or the risk of the impact to them; and
- **Probability of occurrence** is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

In addition to the above-mentioned variables addressed in the impact assessment matrix, for each respective impact that is identified the following was determined:

- The **Direction** of an impact, which may be positive (+), neutral ([]) or negative (-) with respect to the particular impact (e.g., a habitat gain for a key species would be classed as positive, whereas a habitat loss would be considered negative); and
- **Timing** – indicates at what stage the impact would occur i.e. construction, operation, decommissioning and/or post closure.

8.3 Physical Environment

8.3.1 Impact Scoping

The proposed project (all components) are expected to give rise to the following physical impacts, discussed in detail below:

- Changes in topography in the area due to project infrastructure such as TSF, Concentrators, WRDs and declines both at Kansoko and Kakula;
- Soil degradation and loss due to project implementation;
- Increased soil erosion due to mine activities involving the mass movement of earth material;
- Change of land use on the footprints of the proposed mine facilities;
- Increased greenhouse gas in the area due to emissions from mine vehicles, back up diesel generators and pumps and other machinery using fossil fuels;
- Increased dust in the local area due to vehicles, construction works, dust from exposed areas (TSF, WRDs and concentrator sites, decline areas, haul roads etc.), conveyors, transfer, drilling, blasting, loading and ROM areas;
- Noise increase due to installation of above-ground fans for mine ventilation, construction and mine operations;
- Vibration from blasting, crushing, milling and drilling operations at both Kansoko and Kakula mine sites;
- Surface water contamination due to discharges of effluent from mine sites;
- Reduction in surface water availability due to increase in the use of the commodity for mine operations and mineral dressing;
- Ground water contamination due to ground seepage of hydrocarbons and other contaminants stored and used at the mine sites, leachate from the TSF and ARD from WRDs;
- Reduction in groundwater availability due to dewatering of the mines to facilitate operations; and
- Radiation due to the mining radioactive material.

8.3.2 Assessment Criteria

The specific assessment criteria used to determine the intensity of all physical impacts was as follows:

Table 56: Assessment Criteria for Physical Impacts

Intensity		**Extent**	**Duration**	**Value / Capacity of affected component**	**Risk to the human population**	**Probability**	**Frequency**
Rating	**Physical**	**Al Disciplines**	**Al Disciplines**	**Physical**	**All Disciplines**	**All Disciplines**	**All Disciplines**
5 - Very high/ don't know	Detectable change from baseline - exceeds guideline limits / toxic / harmful levels. Exceeds assimilative capacity	5 – International/National (beyond Katanga Province **OR** trans boundary)	5 - Permanent / post closure	Extremely high value to society, academia, research or community - as defined by consultation records **OR** No tolerance and assimilative capacity for an impact.	5 - Very high/don't know (Major loss of assets (>50%), or serious (life threatening) injury / health effect requiring hospital treatment, for an individual / community)	5 - Definite/don't know / >50% chance / definite / statistical evaluation based on discipline	5 - Continuous
4 - High	Detectable change from baseline - exceeds guideline limits - but nontoxic / not beyond assimilative capacity)	4 – Provincial (Whole Katanga Province)	4 - Long-term (>15 years and up to end of operations)	High value to society, academia, research or community - as defined by consultation records **OR** Marginal tolerance and assimilative capacity for an impact.	4 - High (Major loss of assets (>25%), or injury / health effect requiring hospital treatment, for an individual / community).	4 - Highly probable / >25% and <50% chance / statistical evaluation based on discipline	4 - Frequent (daily)
3 – Moderate	Detectable change from baseline - just within guideline limits	3 – Regional (Kolwezi District)	3 - Medium-term (>5 years and <15 years)	Moderate value to local community **OR** moderate tolerance and assimilative capacity for an impact.	3 - Moderate (loss/injury/health effect on more than one local community) or <25% loss of assets for an individual/community)	3 - Medium probability / >10% and <25% chance / statistical evaluation based on discipline	3 - Medium-Frequency (once per week)
2 – Low	Detectable change from baseline - well within guideline limits	2 – Local (20km buffer around project)	2 - Short-term (<5 years)	Low value to local community **OR** High tolerance and assimilative capacity for an impact.	2 - Low Minor (minor loss/injury/health effect to not more than one local community)	2 - Low probability / Possible under accidental conditions / >1% and <10% chance / statistical evaluation based on discipline	2 – Infrequent (once per Month)
1 – Minor	None / no detectable change from baseline - well within guideline limits	1 - Site only i.e. Project infrastructure.	1 – Immediate then dissipates	No value to community - as defined by consultation records **OR** Extremely high tolerance and assimilative capacity for an impact.	1 - Minor (minor loss/injury/ health effect to an individual)	1 - Improbable (<1% chance of occurring, 1 in 100 years) / statistical evaluation based on discipline	1 – Infrequent (once per year

8.3.3 Physical Impact Number 1 – Changes in Topography

Features of Impact

The impact of changes in topography will be moderate in the ***negative*** direction and will occur during the ***construction*** and operation ***phases*** of the project as a result of **decline development, *TSF, WRDs, Concentrator infrastructure*** and other ***high profile facilities***.

The expansion of the mine facilities at Kansoko mine site such as facilities to service the portal, waste rock dump and the proposed Kakula mine site which will also have the decline, concentrator, WRD and the TSF will result in the change of topography in the area. Further underground mining may result in surface subsidence affecting local topography. This infrastructure will impact local topography, affecting local drainage and surface runoff, and affecting the visual landscape. The topographical impacts of the waste rock dumps and TSF will likely extend beyond closure as these infrastructures are permanent in nature. Currently the decline and small waste rock dumps at Kansoko have a minor impact on surface topography, but this is likely to increase as the project progresses.

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The following specific infrastructure will result in the change of topography:

- Waste Rock Dumps at Kakula and Kansoko mine sites;
- Facilities around the declines;
- Tailings Storage Facility; and
- Concentrators

Nature of Impact

Assessment Methods

The impact of change in topography of the area was determined based on the proposed locations of the project infrastructure and their profiles in relation to the existing local topography.

Mitigation

The following mitigation measures are recommended in order to address the impact of change in topography:

- Design the TSF for zero discharge and undertake rehabilitation following closure;
- Carryout subsidence surveys to determine any surface subsidence, and consider amending the mining method to protect surface topography. In the event of subsidence carry out works as necessary to restore surface drainage and prevent ingress to mine workings;
- Undertake annual geotechnical monitoring of the waste rock dumps and TSF for any tailings or rock movements respectively to minimise the risk of any structural collapse which would further impact on topography; and
- Keep the clearance of areas required for the profile facilities such as TSF and WRDs to a minimum area to the extent practical and natural vegetation retained as a screen.

8.3.4 Physical Impact Number 2 – Soil degradation

Features of Impact

The impact of soil degradation will be moderate in ***negative*** direction and will occur during the ***construction, operation and closure phases*** of the project. This will likely occur in areas involving clearance and earth material movements.

The proposed project is mostly a Greenfield project. Therefore, it will be implemented on the soil which was solely used for farming or not utilised in anyway. The extent of the project is about 3600 Hectares. All footprints for facilities such as Concentrators, Decline surface infrastructure, WRDs and the TSF will require land clearance, stripping of soils, removal of organic horizons by heavy machinery and compaction. Currently at Kansoko, soil degradation has occurred for the development of the decline and waste rock dump. Sils are currently being stockpiled for use in future rehabilitation.

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The following construction activities may impact negatively on soil quality:

- Soil clearing and ground levelling;
- Stripping topsoil and sub-soils; and
- Removal of organic horizon by heavy machines during the development of project infrastructure.

Construction activities may result in:

- Loss of natural soil fertility by removing the organic horizon;
- Soil compaction;
- Destruction of the physical properties of the soil;
- Destroyed vegetation and soil organisms; and
- Loss of original soil depth and soil volume.

During the operation phase, the following activities could result in soil degradation:

- Contamination of soils arising from dust deposition and contaminated surface water runoff arising from mining activities and accidental spills that lead to chemical toxicity (acidic and metal-bearing soil and water, concentrating metal and deposition of tailings);
- Soil disturbances caused by, heavy machinery and heavy trucks; and
- Degradation of stockpiled topsoil, due to erosion.

During the decommissioning and closure phase, the following activities could degrade soil quality;

- Loss of previous soil type and their natural fertility due to soil stockpiling;
- Mixing of soils contaminated by heavy metals with topsoil; and
- Soil compaction by heavy machinery and trucks accessing rehabilitation areas.

Nature of Impact

Assessment Methods

The impact of soil degradation in the area was determined based on the proposed locations of the project infrastructure and their relationship to the soils and landuse identified during the baseline assessment.

Mitigation

The following mitigation measures are recommended in order to address the impact of soil degradation:

- Minimize surface footprints to the extent possible and restrict heavy machinery and heavy truck access to sensitive soil areas (Dilungu and Dambo areas);

- Minimize soil contamination through containment and handling of potentially polluting materials and implement Acid Rock Drainage (ARD) and Metal Leaching mitigation measures for identified materials;
- Implement soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation and maintaining soils fertility on topsoil's stored for future rehabilitation);
- Ensure that the overall thickness of the soils utilised for rehabilitation is consistent with surrounding undisturbed areas and future land use;
- Designing slopes to an appropriate gradient for rehabilitation; and
- Basing the soil fertilizing programs on the soil chemical, biological and physical status after topsoil replacement.

8.3.5 Physical Impact Number 3 – Soil Erosion

Features of Impact

The impact of soil erosion will be moderate in the ***negative*** direction and largely likely to occur during ***construction*** and to some extent during ***operations*** and ***closure phases*** of the project.

Soil erosion may occur when topsoil layers are removed for site clearance and construction of surface mine infrastructure such as concentrators, decline surface facilities, TSF, WRDs and other ancillary facilities. This will result in the loss or modification of natural soil horizons, soil fertility, soil drainage, and the natural functioning of the soil (habitat for fauna and flora). Areas sensitive to erosion identified include soil in the hillier landscapes, and Arenosols (particularly in the Dilungus) which are extremely sensitive to erosion. Some soil erosion has been observed along access roads (especially across the Dilungus), Kamoa is currently trying to minimise the number of access roads on Dilungus. Additional work will be required to stabalise existing erosion.

During storm events, high levels of runoff erosion can occur where soil is exposed or compacted, particularly on sloping areas. In the dry season, wind erosion can potentially strip away exposed topsoil.

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities may result in soil erosion:

- Clearance of the area for the TSF construction near Kakula mine site;
- Clearance of areas for mine roads and how they are designed;
- Clearance of areas for WRDs at both mine sites near the declines;
- Clearance of area for concentrators at both mine sites; and
- Clearance of areas for ancillary facilities such as ponds, workshops and administration offices at Kakula mine site.

Nature of Impact

Assessment Methods

The impact of soil erosion in the area was determined based on the proposed concentrators, TSF, declines, WRDs and ancillary facilities and their relationship with the identified areas sensitive to erosion.

Mitigation

The following mitigation measures are recommended in order to address the impact of soil erosion:

- Avoid development of infrastructure in erosion sensitive areas;

- Avoid soil erosion through the design of roads systems with appropriate drainage channels along the roads;
- Scheduling of construction works to avoid heavy rainfall periods (i.e. during the dry season) to the extent practical;
- Contouring and minimizing length and steepness of slopes;
- Mulching to stabilize exposed areas;
- Re-vegetating areas promptly;
- Designing channels and ditches for post-construction flows;
- Lining steep channel and slopes;
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical;
- Segregating or diverting clean water runoff to prevent it mixing with water with a high solids content, to minimize the volume of water to be treated prior to release;
- Limiting access road gradients to the extent practical to reduce runoff-induced erosion;
- Providing adequate road drainage based on road width, surface material, compaction, and maintenance.
- Applying appropriate designs of diversion drains around mine sites, tailings dam and waste rock dumps;
- Undertake annual maintenance of drainage channels especially before the onset of the rainy season;
- Minimising areas of exposed soils;
- Identify and stabilise areas that are highly susceptible to erosion; and.
- On an annual basis, identify, prioritise and rehabilitate eroded areas with appropriate revegetation and/or engineering solutions.

8.3.6 Physical Impact Number 4 – Change in Land Use

Features of Impact

This impact will occur largely during the ***construction phase*** of the project, will be moderate in the ***negative*** direction and will be the result of ***all project infrastructure***.

The proposed project area has a number of potential traditional land uses that will give way to use for mining. Traditional land uses such as agriculture, charcoal production, logging, collection of medicinal plants, human settlement and hunting will continue to be restricted or impeded within the development footprint. No access or farming/logging activities will be permitted within the mine area for safety and security reasons. At Kansoko an exclusion zone has already been established where traditional practices have been restricted and a fence is being constructed to prevent access to the decline. Compensation to affected persons at Kansoko has been completed.

Project implementation activities during the construction phase at Kakula will result in the following land disturbances within the Exclusion Zone:

- For proposed areas of mining-related infrastructure, initial clearing, ground levelling and excavation activities will be required, necessitating development of borrow pits, topsoil stripping and development of soil stockpiles. The consequences of these activities include:
  - Loss of the original spatial distribution of soil types and natural soil horizon sequences;

- Loss of some original soil fertility;
- Loss of original topography and drainage pattern;
- Loss of original soil depth and soil volume; and
- Loss of the natural functioning of the soil (habitat for fauna and flora).

After decommissioning, over time some areas inside the Exclusion Zone at Kakula and Kansoko may be able to provide for the previous land use such as crop land if extensive soil improvement management is undertaken. This will be a positive impact on land use of the site and physical soil disturbance. However, soil properties are likely to be significantly altered due to topsoil stripping and stockpiling and soils spreading during decommissioning.

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in the change of land use:

- Clearance of the area and construction of the TSF near Kakula mine site;
- Clearance of areas and construction of mine roads;
- Clearance of areas for WRDs;
- Clearance of area and construction of concentrators at both mine sites; and
- Clearance of areas and construction of ancillary facilities such as ponds, workshops and administration offices.

Nature of Impact

Assessment Methods

The impact of change in land use was determined based on the proposed locations of the project infrastructure.

Mitigation

The following mitigation measures are recommended in order to address the impact of change in land use:

- Minimise the project footprint and therefore disturbance to a minimal area as possible;
- Restrict access to sensitive soil areas (i.e. use smaller graders in sensitive areas);
- Avoid mixing topsoil with subsoil during storing of topsoil. Topsoil will have to be removed prior to site disturbance from the TSF, WRD, concentrator, decline areas and ancillary facilities. The removed soil will be stockpiled in a particular area and demarcated;
- Identify and investigate sustainable land use options within the mine footprint and adjacent communities; and
- Promote sustainable land use and agricultural practices in the Project Area and adjacent areas.

8.3.7 Physical Impact Number 5 – Greenhouse Gas

Features of Impact

The proposed project will result in additional greenhouse gas (GHG) emissions arising from transportation, back-up diesel generators, general waste facilities, use of explosives, fugitive emissions, imported electrify, oil and fuel use. In addition, site clearance for infrastructure will reduce the amount of vegetation and therefore its ability to capture carbon from the atmosphere. The increase in greenhouse gas emissions, although potentially insignificant on a global scale, will add to the current climate change issues that are being faced globally.

This impact will occur during the ***construction, operations and decommissioning phases*** of the project, the impact will be major in the ***negative*** direction but highly unlikely to occur on the major scale and will be the result of vehicle emissions, other mine equipment using fossil fuels and clearance of vegetation.

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The following specific infrastructure will result in the increase of GHG:

- Emissions from vehicles;
- Emissions from back-up generators;
- Spontaneous combustion at the mine;
- Clearance of vegetation from proposed areas for mine facilities which contributes to the capture of carbon from the atmosphere.

Nature of Impact

Assessment Methods

The impact of increase in GHG was determined based on the proposed equipment to be used at the mine and areas to be cleared to pave way for construction of mine facilities.

Mitigation

Implement a greenhouse gas program which will aim to:

- Enhance energy efficiency for the machines and equipment at the mine site;
- Promote sustainable forms of agriculture and forestry to grow the carbon capture footprint;
- Promote, development and increased use of renewable forms of energy such as solar power; and
- Invest in clean technologies.

8.3.8 Physical Impact Number 6 – Dust Emissions

Features of Impact

Increased dust in the local area is likely to arise due to vehicle movements on dry unsealed roads, construction works, dust from exposed areas (stockpiles, TSF, haul roads etc.), conveyors, transfer and loading areas.

This impact will occur during the ***construction, operations and decommissioning phases*** of the project, will be major in the ***negative*** direction, and will be the result of ***all project infrastructure*** especially the TSF, haul roads and WRDs.

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in dust emissions:

- Movement of vehicles and other mine machinery on dry unsealed roads;
- Dust generating during drilling;

- Dust generating after blasting;
- Dust from exposed areas such as stockpiles, WRDs, construction areas, haul roads during strong winds, active conveyor and Run-Of-Mine areas; and
- Dust blown by strong winds from the TSF.

Nature of Impact

Assessment Methods

The impact of dust emissions was determined based on the proposed mine machinery, plant equipment and mine facilities.

Mitigation

The following mitigation measures are recommended in order to address the impact of dust emissions:

- Wet suppression during materials handling activities;
- Wet suppression of roads;
- Add water sprinklers at the ROM and dust suppressing mechanisms (e.g. wind shields) on conveyors;
- Wind speed reduction through sheltering for open exposed areas prone to wind erosion such as TSF, stockpiles etc. (where possible).
- Practice stockpile height reduction to reduce the stockpiles exposure to wind at elevated heights;
- Progressive rehabilitation and re-vegetation at the TSF, WRDs and other exposed areas;
- Reduction in unnecessary traffic volumes and limit speed to levels not emitting much dust;
- Use of wet suppression during drilling underground; and
- Wash down blasted material before loading and transfer.

8.3.9 Physical Impact Number 7 – Noise

Features of Impact

Project activities throughout construction and operation are likely to increase noise in the local area, potentially affecting employees and nearby sensitive receptors such as local communities as well as local animals.

Impact of vibration on the community and fauna could occur during the ***construction*** and ***operations phases*** of the project. The impact will be moderate in ***negative*** direction and will be the result of ***blasting, drilling, crushing and milling activities.***

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in the increase in noise levels:

- Construction noise from site clearance activities and traffic, as well as the construction of the boxcuts for and development of the declines at Kansoko and Kakula;
- Installation of above-ground mine ventilation fans; and
- Operational noise caused by traffic, processing, ore haulage, and general mining activities.

Nature of Impact

Assessment Methods

The impact of change in noise levels in the area was determined based on the proposed mine machinery and equipment and proposed blasting techniques or underground operations.

Mitigation

The following mitigation measures are recommended in order to address the impact of high noise levels:

- Locate mine ventilation fans away from communities;
- Ventilation exhausts should be designed with noise attenuation and to direct exhaust fumes upwards and not towards receptors;
- Undertake noise monitoring at communities within 3 km of project operations to determine if any exceedance of the DRC noise limits during the day or night due to mining activities and implement noise reduction measures such as:
  - Restricting surface construction activities to daylight hours;
  - Implementation of enclosure and cladding of ore dressing plants;
  - Installation of proper sound barriers and / or noise containments, with enclosures and curtains at or near the source equipment (e.g. crushers, grinders and screens);
  - Establishment of natural barriers at facility boundaries, such as vegetation curtains or soil berms;
  - Optimization of internal traffic routing, particularly to minimize vehicle reversing needs (reducing noise from reversing alarm) and to maximize distances to the closest sensitive receptors (communities);
  - Planning blasting at ROM for hang-ups (boulders) or other noise generating activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance;
  - Avoiding or minimizing project transportation through community areas; and
  - Fitting exhaust muffling devices to combustion engines.
- Undertake occupational health and safety noise monitoring across all construction sites and operational areas. Areas that show noise levels of more than 85dBA will be clearly designated as noisy areas requiring the use of ear protection.

8.3.10 Physical Impact Number 8 – Vibration

Features of Impact

Vibration is likely to be generated during blasting for ore fragmentation underground, blasting for boulders shuts or crushers as well as from operations such as crushing and milling potentially affecting the community, employees, and local fauna.

Impact of vibration on the community and fauna could occur during the ***construction*** and ***operations phases*** of the project. The impact will be moderate in the ***negative*** direction and will be the result of ***blasting, drilling, crushing and milling activities.***

As outlined in Table 57, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in vibration in the area:

- Blasting for ore underground;
- Blasting at ROM and in shuts to fragment hung-up (boulders); and
- Crushing and milling of ore

Nature of Impact

Assessment Methods

The impact of vibration from mining operations was determined based on the proposed mine machinery, equipment and blasting techniques.

Mitigation

The following mitigation measures are recommended in order to reduce vibrations from mining operations:

- Where possible avoid or minimize the use of explosives;
- Adequately designing the foundations of primary crushers and other significant sources of vibration to reduce the impacts of vibration;
- Use specific blasting plans, correct charging procedures and blasting ratios, delayed / micro delayed or electronic detonators, and specific in-situ blasting tests (the use of down hole initiation with short-delay detonators improves fragmentation and reduces ground vibrations); and
- Monitor ground vibration at sensitive receptors and evaluating any impact on structures such as houses should they occur.

8.3.11 Physical Impact Number 9 – Surface water contamination

Features of Impact

Changes in water quality will occur during the ***construction, operations and decommissioning phases***. The impact will be moderate in the ***negative*** direction and will be the result of ***all project infrastructure.***

Site clearance, multiple infrastructure developments, mine waste facilities, decline developments, effluent discharge, air quality impacts and geochemical impacts as well as potential use of surface water for the Project may mean that impacts to surface water could potentially be significant. Further any TSF failure would likely result in significant siltation and contamination of the Kakula stream should it occur.

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in the contamination of water:

- Reduced quality of runoff and seepage from WRDs, TSF, concentrators, chemical storage areas, hazardous and general waste storage facilities;
- Accidental effluent discharge from the process water pond, TSF and sewage systems;
- Effluent discharge from mining operations (i.e. excess water from underground dewatering operations);
- Accidental discharge of grease, oil, fuel and other hydrocarbon from storage facilities, refuelling stations and workshops;
- Erosion resulting in mobilisation of solids into streams and rivers from exposed road surfaces and other cleared areas;
- Accidental spills (i.e. tailings pipeline leakages, TSF failure or spills of hazardous chemicals or acid);

- Breaches in storm water or effluent storage systems due to high intensity events due to climate change resulting in additional surface water contamination; and
- Acid Rock Drainage (ARD) and Metal Leaching (ML).

Nature of Impact

Assessment Methods

The impact of surface water contamination was determined based on the proposed mine facilities, raw materials to be used for ore processing. Storm events and impacts of climate change.

Mitigation

The following mitigation measures are recommended in order to address the impact of surface water contamination:

- Operate the mine sites and TSF as zero discharge operations with internal dirty (greywater) water circulated within the plant for use;
- Establish water controls where necessary;
- Design, construct and maintain temporary drainage installations for recurrence periods of at least a 25 - year/24-hour event, with permanent drainage installations designed for a 100 - year/24-hour recurrence period.
- Reduce or prevent off-site sediment transport (e.g. by using of settlement ponds, silt fences);
- Manage water quality by establishing salt balances at both mine sites;
- Keep clean water away from the site through the use of sufficiently sized channels;
- Keep dirty water contained so that it cannot be discharge to the environment but reused within the plant;
- Ensure that the TSF is designed, commissioned and operated by professionally registered individuals;
- Apply erosion controls to minimise sediment runoff;
- Ensure that sewage is managed via chemical, portable toilets during construction activities until permanent structures are managing and treating sewage are in place; and
- Limit the effect that the mine has on the surrounding environment by limiting the discharge to surface water in the environment (if recycling is not practical) by only discharging water of a suitable quality.

8.3.12 Physical Impact Number 10 – Reduction in Surface Water

Features of Impact

The majority of the process water for the proposed Project will be supplied from underground dewatering and as indicated the Project is likely to have an oversupply of groundwater, of which clean water will be discharged into streams and dirty water returned underground following settlement. There will be a requirement for minimal water abstraction from the watercourses in the area during construction however this is relatively small compared to the existing flow in streams which will unlikely to significantly affect surface water availability at the local level for local communities, plants and animals.

Changes in quantity of surface water could occur during the ***construction phase***. The impact will be moderate in the ***negative*** direction and will be the result of water abstraction from local watercourses***.***

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities will result in the reduction of surface water:

- Water abstraction for initial construction..

Nature of Impact

Assessment Methods

The impact of change in quantities of surface water was determined based on the assessed water use evaluation.

Mitigation

The following mitigation measures are recommended in order to address the impact of surface water reduction:

- Implement adequate monitoring and management of water use, in addition to treatment of effluent streams including storm water run-off from Kansoko and Kakula mine sites;
- Minimise water use by reusing, recycling, or treating process water where feasible (e.g. return of supernatant from a tailings pond to the process plant); and
- Minimise the proposed project footprint as far as practicable;
- Manage water use by establishing a water balance (including probable climatic events) for the mine and related process plant circuit and using this to improve mine infrastructure design.

8.3.13 Physical Impact Number 11 – Groundwater Contamination

Features of Impact

This impact will be major in the ***negative*** direction could occur during ***construction, operations and decommissioning phases*** of the project and will be the result of seepage to ground of contaminants from mine facilities.

Groundwater impacts could arise from seepage of contaminated water into groundwater aquifers, from the WRD, TSF, concentrators, chemical storage areas, hazardous and general waste storage facilities, sewage systems, accidental spillages, and mining operations.

Contamination could also result from Acid rock drainage and metal leaching arising from underground areas, waste rock and tailings. Based on acid generation potential specified in the DRC Mining Code the KPS and upper Diamictite are high risk waste material that may require an engineered barrier to limit impacts on the receiving environment in the vicinity to of the proposed Waste Rock Dump. All other waste sources are classified as low risk and therefore do not need any containment measures and will likely be utilised for road aggregate or tailings wall construction. Kamoa anticipate that there will be approximately 60,000 tonnes of KPS and upper diamictite waste generated from the Kansoko mine and likely a similar amount from Kakula. These sources of ARD / ML could result in local contamination of groundwater at the waste rock dump and potentially in exposed areas of the underground mines post closure.

The assessment further indicated that the tailings is classified as leachable waste, and therefore metal leaching of Cu and Fe may impact ground and surface water resources if the TSF is not properly designed and operated.

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The following specific activities could cause groundwater contamination:

- Waste rock (with ARD potential) disposal on the dedicated waste rock dump(s) and TSF construction;

- ARD and ML from exposed geology resulting in poor quality effluent arising from the WRDs and TSF;
- Geochemical changes and weathering in WRDs and TSF could result in changes to the stability of these facilities, resulting in an increased risk of erosion and potential failure;
- Tailings disposal from the processing of the ore onto the new TSF; and
- Stockpiling of materials.

Nature of Impact

Assessment Methods

The impact of groundwater contamination was determined based on the available ARD and ML test work, proposed mine waste disposal facilities, generated mine waste such as waste rock and tailings.

Mitigation

The following mitigation measures are recommended in order to address the impact of groundwater contamination:

- Implement the contamination mitigation as for surface water impacts (particularly with regards to the TSF and WRD);
- Minimise water use as per surface water impact mitigation measures;
- Implement ARD and ML preventive actions such as:
  - Limiting exposure of potentially acid generating (PAG) materials by phasing development and construction, together with covering, and/or segregating runoff for treatment;
  - Containing metal leaching or ARD through adequate placement of liner and leachate collection system below the appropriate facilities;
  - Implementation of water management techniques such as diverting clean runoff away from PAG materials, and segregating “dirty” runoff from PAG materials for subsequent treatment; grading PAG material piles to avoid ponding and infiltration; and removing pit water promptly to minimize acid generation;
  - Controlled placement of PAG/ARD materials (including wastes) to provide permanent conditions that avoid contact with oxygen or water including:
    - Submerging and/or flooding of PAG/ARD materials by placing them in an anoxic (oxygen free) environment, typically below a water cover;
    - Isolating PAG/ARD materials above the water table with an impermeable cover to limit infiltration and exposure to air; and/or
    - Blending of PAG/ARD materials with non-PAG/ARD or alkaline materials to neutralize acid generation, as appropriate.

8.3.14 Physical Impact Number 12 – Reduction in Groundwater

Features of Impact

Simulated drawdown in the upper diamictite aquifer at the end of mining (year 2047) undertaken using the numerical hydrogeological model described in Section 5.9. The model evaluated 4 different scenarios:

- Scenario 1: UGM inflow is1.5 l/s per km^2 of mining after 30 years (Best case);
- Scenario 2: UGM inflow is 50 l/s per km^2 of mining after 30 years (Realistic to worst case);
- Scenario 3: UGM inflow is 140 l/s per km^2 of mining after 30 years (Unrealistic case); and

- Scenario 4: UGM inflow is 7 l/s per km^2 of mining after 30 years (Probably most realistic case).

The drawdown evaluated in the model for each scenario was determined as follows:

- **Upper Diamictite Aquifer -** Modelling indicates that the water level drawdown that the maximum effect of dewatering on the Upper Diamictite aquifer is as follows:
  - **Scenario 1 (Best case)** – Low (in the order of 0.5-1m maximum at the end of the mine in 30 years) with the rebound to 0.1m below baseline levels occurring 50 years after mine closure;
  - **Scenario 2 (Realistic to worst case)** – Major (in the order of 70m maximum at the end of the mine in 30 years) with the rebound to 0.5m below baseline levels occurring 50 years after mine closure;
  - **Scenario 3 (unrealistic case)** - Severe (in the order of 600m maximum at the end of the mine in 30 years) with the rebound to 1.5m below baseline levels occurring 50 years after mine closure;
  - **Scenario 4 (Probably most realistic case)** – Low (in the order of 8m maximum at the end of the mine in 30 years) with the rebound to 0.3m below baseline levels occurring 50 years after mine closure;
- **Basal Sandstone Aquifer -** Modelling indicates that the water level drawdown that the maximum effect of dewatering on the Basal Sandstone aquifer is as follows:
  - **Scenario 1 (Best case)** – Low (in the order of 6m maximum at the end of the mine in 30 years) with the rebound to 0.25m below baseline levels occurring 50 years after mine closure;
  - **Scenario 2 (Realistic to worst case)** – Major (in the order of 250m maximum at the end of the mine in 30 years) with the rebound to 1m below baseline levels occurring 50 years after mine closure;
  - **Scenario 3 (unrealistic case)** - Severe (in the order of 600m maximum at the end of the mine in 30 years) with the rebound to 3m below baseline levels occurring 50 years after mine closure;
  - **Scenario 4** (**Probably most realistic case)** – Low (in the order of 38m maximum at the end of the mine in 30 years) with the rebound to 2m below baseline levels occurring 50 years after mine closure;

The extent of drawdown for each scenario extends up to 10km from the mining areas. This evaluation has been undertaken for the Kansoko area and on a mine plan that is now being amended. However, it is likely that there would not be any significant change to the impact of groundwater reduction.

Communities do utilise the groundwater in the area and the groundwater does feed some of the streams in the project area. Applying the precautionary principles, Scenario 2 has been selected for the impact evaluation and therefore the impact is assessed as major in the ***negative*** direction and will occur during the ***operation phase*** of the project and will be the result of dewatering of underground mines. See Figure 72 to Figure 75.

As outlined in Table 57, this impact is rated as negative, major prior to mitigation and negative, low following mitigation.

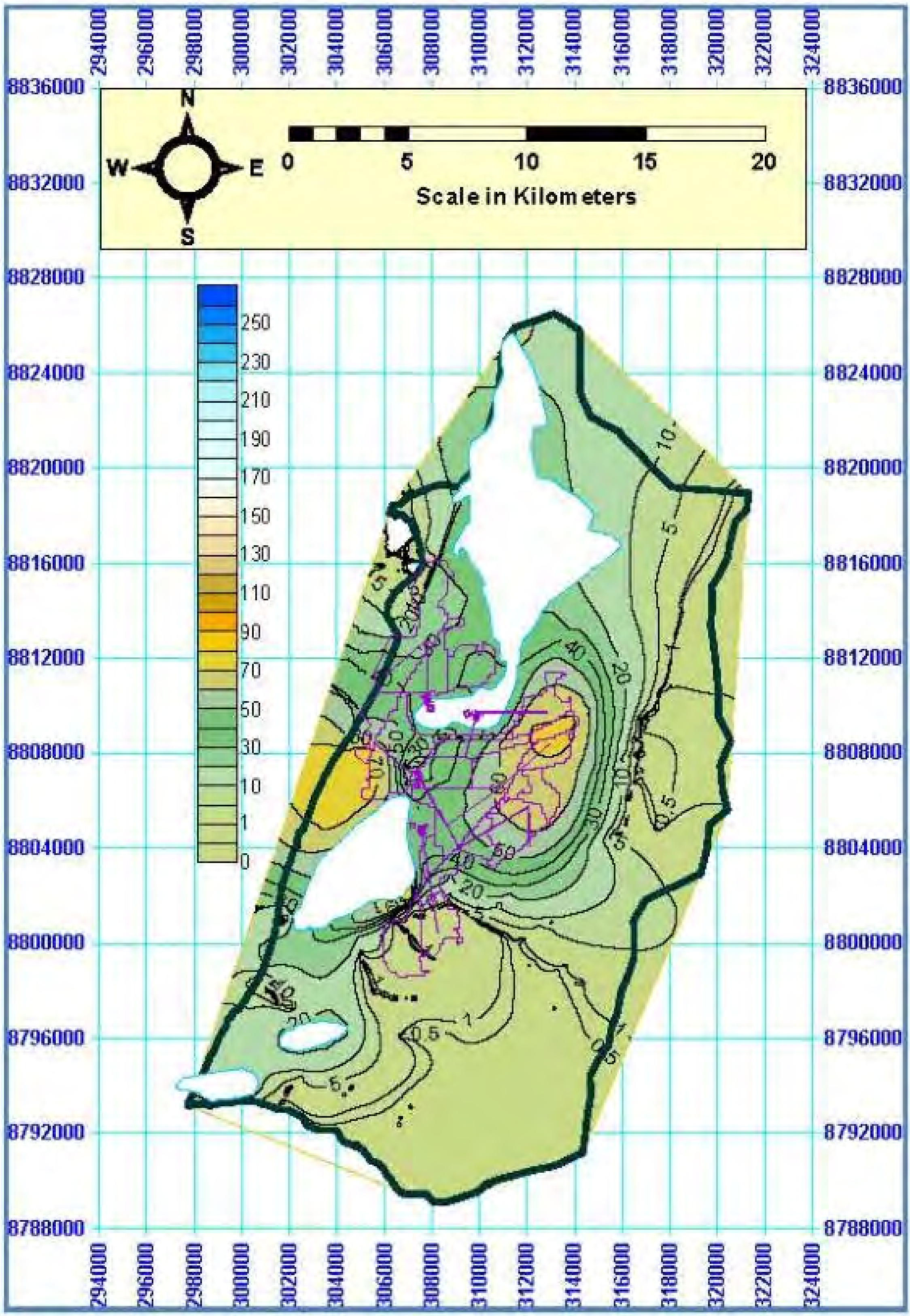


Figure 72: Simulated drawdown at the end of mining (year 2047) for Scenario 2 in the Upper diamictite aquifer

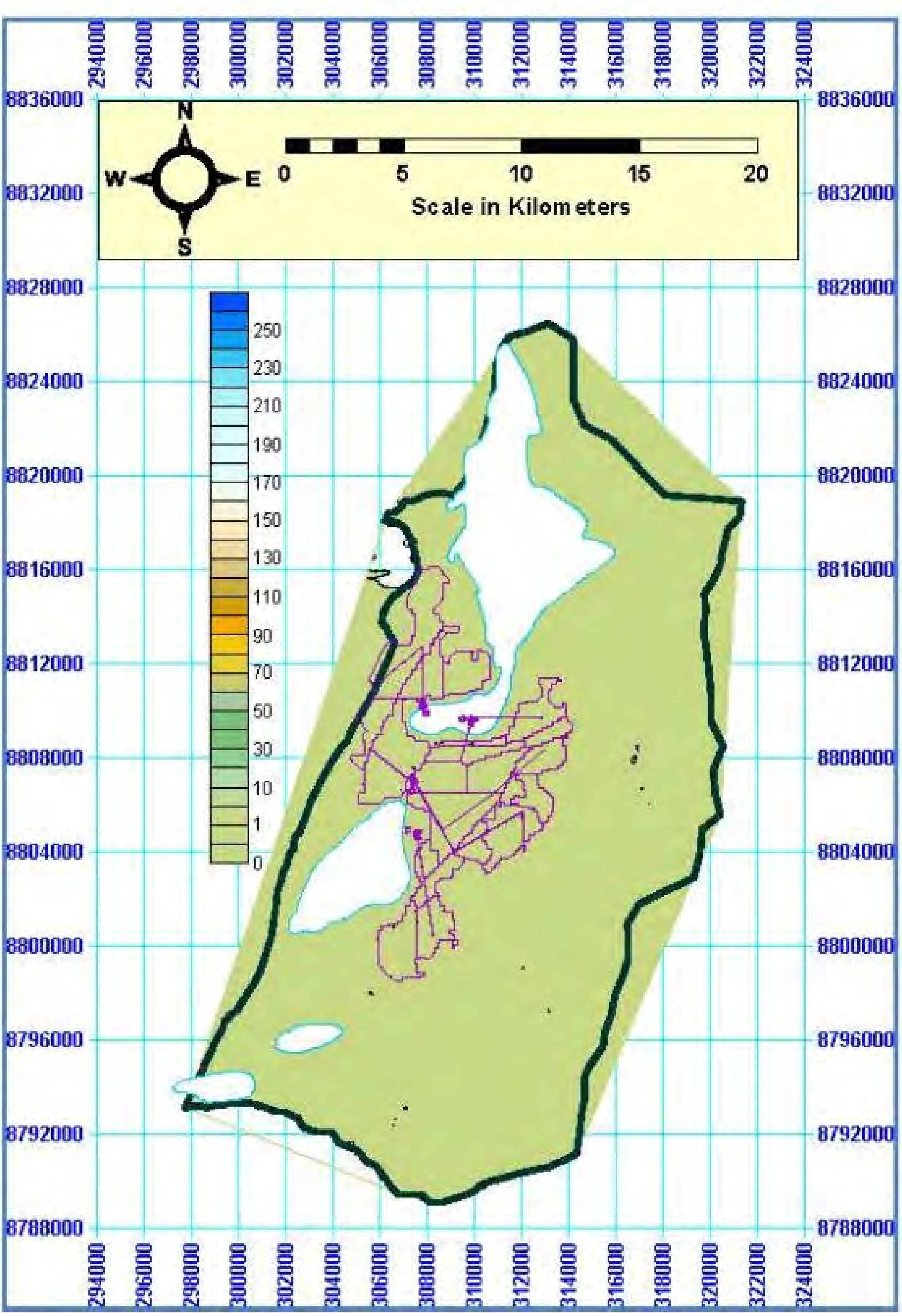


Figure 73: Simulated drawdown at the end of 50 years post mining (year 2097) for Scenario 2 in the Upper diamictite

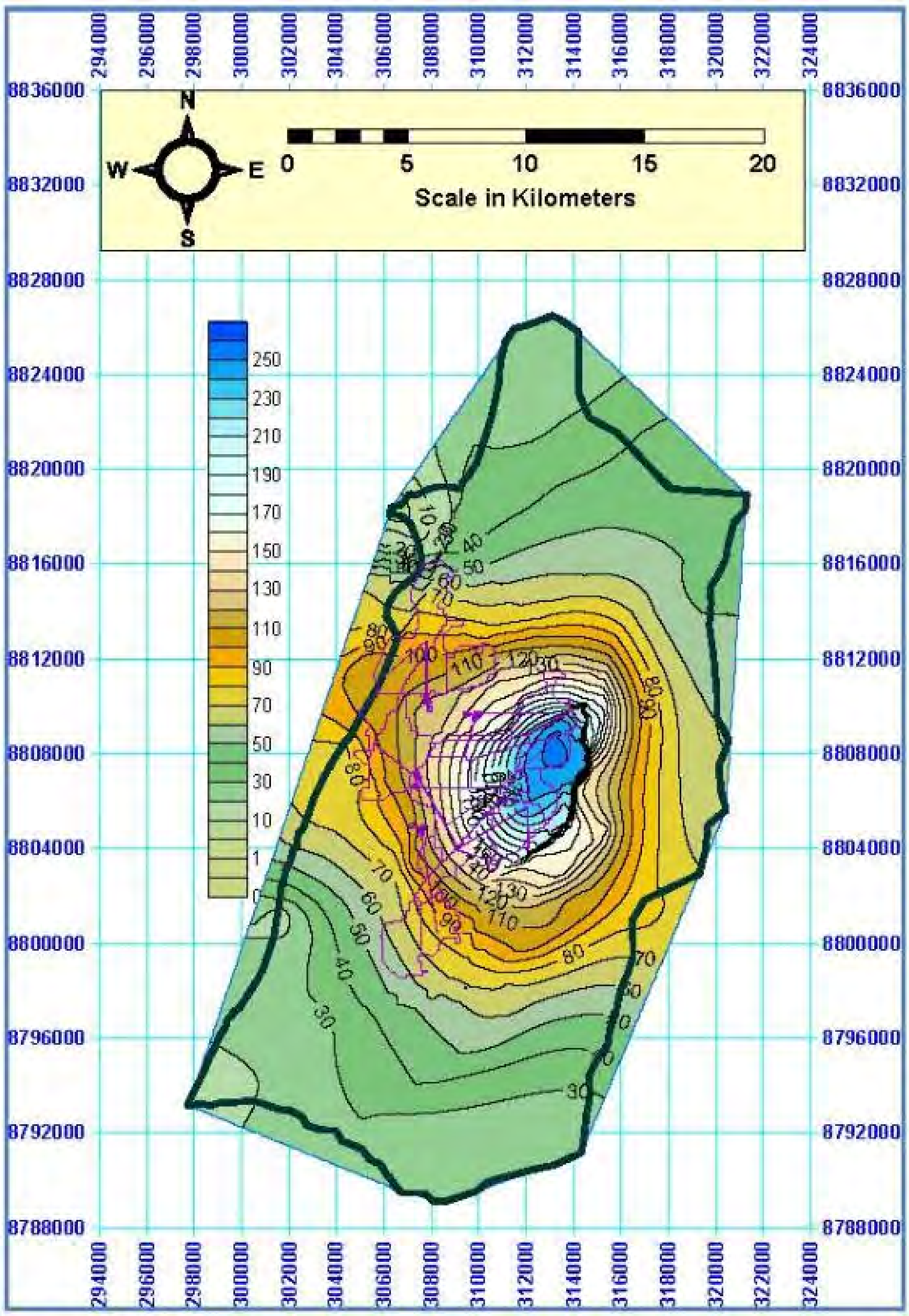


Figure 74: Simulated drawdown at the end of mining (year 2047) for Scenario 2 in the Lower basal sandstone aquifer

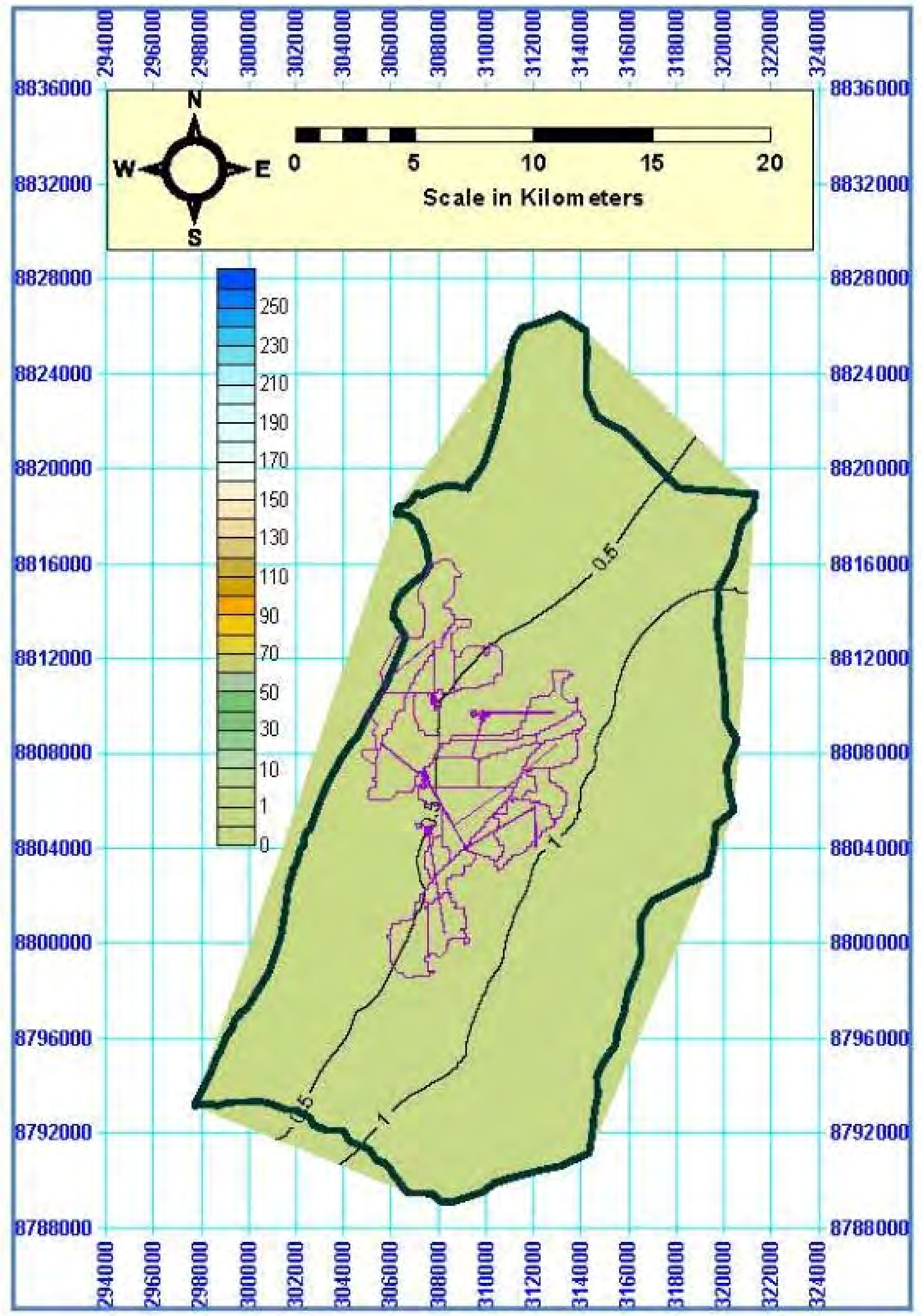


Figure 75: Simulated drawdown at the end of 50 years post mining (year 2097) for Scenario 2 in the Basal sandstone aquifer

Operations that will have an Impact on the Environment

The following specific infrastructure will result in the reduction of groundwater:

- Dewatering of the underground mines.

Nature of Impact

Assessment Methods

The impact of reduction in groundwater was determined based on simulations of the potential drawdown of dewatering of the Kansoko mine based on previous mine plans utilising the hydrogeological model presented in Section 5.9. A professional opinion was made on the likely extent of drawdown for the likely mine plan at Kakula and Kansoko which are currently being updated.

Mitigation

The following mitigation measures are recommended in order to address the impact of groundwater reduction:

- Update the model based on the new mine plan to determine impacts and update the model on a regular basis to more accurately predict impacts;
- Undertake monitoring of groundwater quality and levels for potential effects of dewatering and /or contamination on local boreholes and developing contingency measures to re-supply affected local communities with water as may be necessary; and
- Continue with stream flow monitoring to determine if any changes to flow result from dewatering. Supplement any flow reductions with clean dewatering water discharged to rivers using appropriate design to minimise risk of erosion.

8.3.15 Physical Impact Number 13 – Effects of Radiation

Features of Impact

The radiological assessment undertaken for Kamoa indicated that the radiation baseline at Kamoa was similar to natural global norms with no elevated risk identified. Some additional radiation exposure may occur due to the following:

- Mobilisation of soils and sediment containing radioactivity into nearby watercourses due to site construction activities;
- Dust inhalation of re-suspended particles containing radioactivity due to site construction activities;
- Dust deposition in surrounding environment of airborne radioactivity due to site construction activities;
- Radon inhalation due to disturbance in soils/geology of the area as a result of site construction activities allowing radon gas to be more readily released ; and
- Soil and food contamination which are mainly related to the transfer of activity from the soil to plants used as food, directly or via forage or pasture. Soil contamination again mainly associates with water contamination through irrigation (see bullet one) and/or dust deposition

Due to the low risk of radiation identified in the baseline studies, this impact has been assessed as negligible in the ***negative*** direction and may occur during ***the construction, operation and decommissioning phases*** of the project and will be the result of the mining of radioactive material.

As outlined in Table 57, this impact is rated as negative, negligible prior to mitigation and negative, negligible following mitigation.

Operations that will have an Impact on the Environment

The following specific activities could pose a health hazard to the community and the general environment:

- Underground mining releasing radon gas;
- Land clearance resulting in the mobilisation of sediment containing radioactive material into streams and rivers; and
- Mining activities increasing dust (which may contain radioactive particles).

Nature of Impact

Assessment Methods

The impact of radioactive material effects was determined based on the mineralogy of the ore to be mined at the proposed mine project and the assessment of radiological risk carried out by NECSA in 2013.

Mitigation

The following principle mitigation measure is recommended in order to address the impact of the radioactive material:

- Minimize by means of applying dust suppression techniques in areas where site clearance/ construction and mining operations take place. These measures typically would be dust suppression by spraying of water in areas/roads etc. where high volume traffic e.g. trucks etc. are found.
- Rehabilitate/Repair of waste storage areas, e.g. at tailings facilities; by limiting Dust inhalation (re-suspension), Dust deposition, Radon gas releases and contaminated water (leaching) For example; vegetate TSF to prohibit dust releases. Ensure TSF facilities do not release contaminated water etc.
- Early identification of potential impacts through a continuous radiological environmental monitoring programme.

8.3.16 Certainty of Assessment

For the Physical Impacts evaluated the level of certainty based on professional opinion, experience, and where indicated quantitative modelling (e.g. for groundwater drawdown), gives an overall medium to high confidence of the prediction of impacts outlined above.

8.3.17 Physical Impact Assessment Summary

Table 57: Physical Environmental Impact Assessment Summary

ID	Aspect	Phase / Timing	Impact Summary	Impact Characterisation – Prior to Mitigation											Impact Characterisation – Post Mitigation										
				Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	Probability of Occurrence	**Overall Risk (Magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	**Probability of Occurrence**	**Overall Risk (magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency
ENV01	Topography	Construction/ Operations/ Closure	Topographical impacts resulting from the proposed WRDs near Kansoko and Kakula portals, concentrators at both mine sites and the TSF located at Kakula. Subsidence due to underground mining affecting topography.	neg	3	2	5	3	2	3	5	15	Mod	5	neg	3	2	4	3	1	2.6	5	13	Mod	5
ENV02	Soils, Land Use and Land Capability	Construction/ Operations/ Closure	Soil degradation and loss due to project implementation.	neg	3	2	4	4	1	2.8	5	14	Mod	5	neg	1	1	4	3	1	2	5	10	Mod	5
ENV03	Soils, Land Use and Land Capability	Construction/ Operations	Increased soil erosion to earth material movement	neg	3	1	4	4	1	2.6	4	10.4	Mod	4	neg	1	1	4	3	1	2	3	6	Low	4
ENV04	Soils, Land Use and Land Capability	Construction/ Operations	Change of land use on the footprints of the proposed mine facilities.	neg	3	1	4	4	1	2.6	5	13	Mod	5	neg	3	1	4	2	1	2.2	5	11	Mod	5
ENV05	Air quality	Construction/ Operations	Increased greenhouse gas due to emissions from project vehicles and other mine machinery using fossil fuels	neg	1	5	4	1	1	2.4	5	12	Mod	4	neg	2	2	4	1	1	2	5	10	Mod	4
ENV06	Air quality	Construction/ Operations	Increased dust in the local area due to vehicles, construction works, dust from exposed areas (TSF, WRDs and concentrators sites, portal areas, haul roads etc.), conveyors, transfer, drilling, blasting, loading and ROM areas	neg	3	2	4	4	5	3.6	5	18	Maj	4	neg	2	1	4	3	1	2.2	3	6.6	Low	4
ENV07	Noise	Construction/ Operations	Noise increases due to construction, mine operations and installation of above-ground ventilation vans for the mines	neg	3	2	4	5	5	3.8	4	15.2	Maj	4	neg	2	1	4	3	1	2.2	4	8.8	Low	4
ENV08	Vibration	Construction/ Operations	Vibration from blasting, crushing, milling and drilling operations at both Kansoko and Kakula mine sites.	neg	2	2	4	4	4	3.2	4	12.8	Mod	4	neg	1	2	4	2	2	2.2	4	8.8	Low	4

ID	Aspect	Phase / Timing	Impact Summary	Impact Characterisation – Prior to Mitigation											Impact Characterisation – Post Mitigation										
				Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	Probability of Occurrence	**Overall Risk (Magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	**Probability of Occurrence**	**Overall Risk (magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency
ENV09	Surface Water	Construction/ Operations	Surface water contamination due to discharges of effluent from the mine sites	neg	3	3	4	4	5	3.8	4	15.2	Maj	4	neg	1	1	4	4	1	2.2	3	6.6	Low	4
ENV10	Surface Water	Construction/ Operations	Reduction in surface water availability due to increase in the use of the commodity for mine operations and mineral dressing	neg	2	2	4	4	1	2.6	4	10.4	Mod	4	neg	1	2	4	4	1	2.4	3	7.2	Low	4
ENV11	Groundwater	Construction/ Operations	Ground water contamination due to ground seepage of hydrocarbons and other contaminants stored and used at the mine sites, leachate from the TSF and ARD from the WRDs	neg	4	2	4	5	5	4	4	16	Maj	3	neg	2	2	4	4	2	2.8	3	8.4	Low	3
ENV12	Groundwater	Construction/ Operations	Reduction in ground water availability due to dewatering of the mines to facilitate mining operations	neg	5	2	4	4	4	3.8	4	15.2	Maj	3	neg	2	2	4	4	4	3.2	2	6.4	Low	3
ENV13	Radiation	Operations	Mining of radioactive material could be a health hazard to people and the general environment.	neg	1	2	5	4	5	3.4	1	3.4	Non	1	neg	1	2	4	4	5	3.2	1	3.2	Non	1

8.4 Biological Environment

This section identifies the positive and negative, direct or indirect impact or risk of the biological impacts associated with project within the project perimeter and in the area neighbouring the perimeter that may be affected.

8.4.1 Impact Scoping

The proposed project (all components) are expected to give rise to the following biological impacts, discussed in detail below:

- Reduced vegetation from clearing;
- Contamination from harmful substances;
- Sensory disturbances from vibration and noise;
- Degraded ecology from reduced air quality;
- Local migration of animals;
- Increase in exotic and/or invader species;
- Degraded ecology from human presence;
- Degradation of aquatic habitats;
- Reduced diversity and abundances of aquatic fauna; and
- Loss and fragmentation of riparian and watershed grassland habitat.

8.4.2 Assessment Criteria

The specific assessment criteria used to determine the intensity of all biological impacts was as follows:

Table 58: Assessment Criteria for Biological Impacts

Intensity		Extent	Duration	Value / Capacity of affected component	Risk to the human population	Probability	Frequency
Rating	**Biological**	**Al Disciplines**	**Al Disciplines**	**Biological**	**All Disciplines**	**All Disciplines**	**All Disciplines**
5 - Very high/ don't know	>50% loss of ecosystem or habitat in the Project area **OR** Any impact on critical, endangered, endemic species / habitats or protected species.	5 – International/National (beyond Katanga Province **OR** trans boundary)	5 - Permanent / post closure	Extremely high value to society, academia, research or community - as defined by consultation records **OR** extremely sensitive with no tolerance and assimilative capacity for an impact **OR** Internationally protected, critical, endangered or endemic species, habitat or ecosystem.	5 - Very high/don't know (Major loss of assets (>50%), or serious (life threatening) injury / health effect requiring hospital treatment, for an individual / community)	5 - Definite/don't know / >50% chance / definite / statistical evaluation based on discipline	5 - Continuous
4 - High	Significant (>10% and <50%) impairment to ecosystem/habitat in Project area.	4 – Provincial (Whole Katanga Province)	4 - Long-term (>15 years and up to end of operations)	High value to society, academia, research or community - as defined by consultation records **OR** no tolerance and assimilative capacity for an impact **OR** DRC protected species, habitat or ecosystem.	4 - High (Major loss of assets (>25%), or injury / health effect requiring hospital treatment, for an individual / community).	4 - Highly probable / >25% and <50% chance / statistical evaluation based on discipline	4 - Frequent (daily)
3 – Moderate	Moderate change to baseline conditions **OR** detectible impact on ecosystem function, habitats or species **OR** Loss of < 10% of habitat type in project area.	3 – Regional (Kolwezi District)	3 - Medium-term (>5 years and <15 years)	Moderate value to society, academia, research or community - as defined by consultation records **OR** moderate tolerance and assimilative capacity for an impact /common habitats, ecosystems and species (not protected).	3 - Moderate (loss/injury/health effect on more than one local community) or <25% loss of assets for an individual/community)	3 - Medium probability / >10% and <25% chance / statistical evaluation based on discipline	3 - Medium-Frequency (once per week)
2 – Low	Minor change to baseline conditions but no impact on ecosystem function, habitats or species.	2 – Local (20km buffer around project)	2 - Short-term (<5 years)	Minimal value to society, academia, research or community - as defined by consultation records **OR** high tolerance and assimilative capacity for an impact **OR** common habitats, ecosystems and species (not protected).	2 - Low Minor (minor loss/injury/health effect to not more than one local community)	2 - Low probability / Possible under accidental conditions / >1% and <10% chance / statistical evaluation based on discipline	2 – Infrequent (once per Month)
1 – Minor	None / slight change in baseline conditions - almost undetectable	1 - Site only i.e. Project infrastructure.	1 – Immediate then dissipates	No value to society, academia, research or community - as defined by consultation records **OR** Extremely high tolerance and assimilative capacity for an impact.	1 - Minor (minor loss/injury/ health effect to an individual)	1 - Improbable (<1% chance of occurring, 1 in 100 years) / statistical evaluation based on discipline	1 – Infrequent (once per year

8.4.3 Biological Impact Number 1 - Vegetation clearing

Features of impact

The impact of vegetation clearing will occur ***pre-construction phase*** and potentially during the ***construction phase*** depending on project schedule. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Due to the nature of the mining operations and the methods used in the mining process, vegetation clearing is inevitable and unavoidable (as is the case at Kansoko where project infrastructure has been developed). This may inadvertently lead to loss of species of conservation importance in the Project Area (such as Red Data species). With careful rehabilitation it should be significantly reduced in the decommissioning and post-closure phases.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Land clearance resulting in losses to terrestrial ecosystems.

Nature of impact

Assessment Methods

Vegetation clearing is a total transformation impact and therefore 100% loss of vegetation and associated fauna habitat is assumed, in the areas affected.

Because of the nature of this impact (i.e. total transformation), the percentage loss of each vegetation community based on a calculation on GIS was used to give an indication of the scale of the impact, similarly the sensitivity of the habitat was used as an indication of intensity.

Mitigation

Mitigation can be achieved by the following methods:

- The impact can be mitigated by limiting the clearing of vegetation to the proposed footprint areas and prevent avoiding any unnecessary clearing of vegetation outside the proposed project footprint areas of the proposed opencast and mining related infrastructure areas.
- Identifying and avoiding sensitive areas and implementing buffer zones;
- Restricting surface disturbances to the extent possible and re-vegetating disturbed areas with plants indigenous to the Project area and mine waste facilities;
- Siting access routes and facilities in locations that avoid impacts to critical terrestrial habitat (such as dilungus or untransformed Miombo woodland, and carrying out exploration and construction activities to avoid sensitive times of the year;
- Avoid or minimize the creation of barriers to wildlife movement, or threats to migratory species (such as birds) and provide alternative migration routes when the creation of barriers cannot be avoided;
- Furthermore, mitigation of this impact can further be achieved by careful removal and replanting of plants of conservation importance.
- Seed collection, propagation and re-planting of saplings to make up for lost species should also be applied.
- Monitoring of vegetation communities and associated fauna should be conducted throughout the life of mine in order to advise management decisions in order to keep impacts to a minimum.

- This impact can be further reduced through offsetting as this area is being rapidly degraded. Conservation of Miombo woodland will greatly mitigate this impact, this may be achieved through protection of the untransformed Miombo woodland to the west of the study area.

8.4.4 Biological Impact Number 2 - Contamination from harmful substances

Features of impact

The impact of contamination from harmful substances may occur during ***all phases of the project***. The impact will be ***negative*** and the result of construction, ***mining operations and processes.***

The spillage of harmful or toxic substances may impact on the fauna and flora of the area in a number of ways. Direct pathways include ingestion of the substances by fauna species resulting in toxicity in that individual, uptake of toxic chemicals by the roots of plants which may lead to toxicity in the plants and the chemicals entering the plant or animals system due to contact (through the skin, leaves or stems). Indirect pathways include the ingestion of contaminated plants or animals by other herbivorous or predatory species. The predation of contaminated animals by both other animals and humans is a common occurrence during chemical contamination due to these animals being sluggish, and less likely to escape predation, due to chemical toxicity.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Contamination of soils and water sources from accidental spills and /or contamination from stockpiles, waste rock dumps and/or the TSF.

Nature of impact

Assessment Methods

The impact of contamination in the area was determined based on the assessment of potential ARD and ML for the TSF and WRDs, chemicals likely to be used and experience of other similar mining operations.

Mitigation

Mitigation measures for contamination of air, water and soils resources are documented in Section 8.3, the principles of which are:

- Implementing engineering design and operation for all project infrastructure particularly fuel storage tanks, the TSF and WRDs to achieve the relevant DRC environmental standards;
- Minimising the use of hazardous materials to the extent possible (through the evaluation of alternative greener technologies);
- Establishing and implementing hazardous materials handling, storage and spills procedures (particularly for oils and fuels);
- Establishing comprehensive maintenance programs for equipment and vehicles; and
- For pesticides and herbicides - Employing biological, mechanical and thermal vegetation control measures and avoiding the use of chemical herbicides as much as possible.

8.4.5 Biological Impact Number 3 - Sensory Disturbances due to Vibration and noise

Features of impact

The impact of sensory disturbances from vibration and noise may occur through **all phases of the project**. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Vibration and noise will have a significant effect; mainly on fauna species in the immediate vicinity of the mine, haul roads, processing plants and waste dump areas, due to the heavy machinery utilised for the extraction and transport of the ore. Vibration can affect a number of subterranean fauna taxa, such as burrowing mammals, reptiles and arthropods. Vibration affects these animals by causing the collapsing of burrows, and causing these animals to leave the area due to the vibration (Brodziewska, 2005).

Noise will also affect a wide range of taxa including avifauna, mammals, reptiles, amphibians and arthropods. Avifauna, especially songbirds, and amphibians may find it difficult to find mates in areas of increased noise, mammals, reptiles and arthropods may find increased noise disturbing and therefore move away from the area (Brumm, 2004; Canaday & Rivadeneyra, 2001).

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Noise and vibration form construction and operational activities causing sensory disturbances.

Nature of impact

Assessment Methods

In order to determine the intensity of the impact, a 3km buffer was established around all project infrastructure (as this is the maximum distance that noise and vibration are perceptible to the human ear (see the noise and vibration study). It was assumed that fauna within this buffer zone would be affected by construction and operational activities.

Mitigation

Applying the measurers outlined for noise and vibration mitigation will reduce noise and vibration impacts. In summary these mitigation measures include (it is important to remember that fauna may be more susceptible to noise and that further studies are recommended to determine the actual effects on noise):

- Avoiding or reducing noisy activities;
- Applying noise and vibration reduction procedures (particularly for blasting); and/or
- The insertion of noise screening, such as bunds or acoustic fencing.

8.4.6 Biological Impact Number 4 - Degraded Ecology from reduced Air Quality

Features of impact

The impact of degraded ecology from reduced air quality may occur through all phases of the project. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Increased atmospheric dust may occur in the vicinity of the mining areas and associated infrastructure. Dust may be caused by blasting, heavy machinery moving along haul roads or dirt roads, crusher plants, and waste sites. Dust in the area will be greatly increased in the dry season due to the nature of the soil in the area, with very small particulate sizes. Dust settling on plant material can reduce the amount of light reaching the chlorophyll in the leaves, thereby reducing photosynthesis, which in turn reduces plant productivity, growth and recruitment.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Dust and air emissions from construction and operational activities particularly traffic and dust blow fom the TSF affecting flora and fauna.

Nature of impact

Assessment Methods

The findings of the air quality impact assessment was utilised to inform the assessment of this impact.

Mitigation

Mitigation can be achieved by implementing the mitigation measures outlined for air quality such as:

- Dust suppression on roads by water bowsers.
- Maintaining exposed excavations, disturbed ground surfaces, and unpaved traffic areas in a moist condition.
- Provide temporary cover and daily maintenance for soil or fill stockpiles and keep active surfaces moist.
- Construction activities should be conducted using methods that minimize dust generation.
- All onsite traffic can be restricted to specific designated roads. Off-road travel can only be authorized on a case-by-case basis (e.g. access to a remote monitoring well, etc.).
- Traffic speed can also be restricted to an appropriate level on all designated roads. All designated roads can be considered as high potential dust source areas, and as such, can be a priority for dust controls utilizing water and/or gravel. This plan can be in effect during all hours of operation at the site

8.4.7 Biological Impact Number 5 - Local migration of animals

Features of impact

The impact of local migration of animals may occur through all phases of the project. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Local migrations of fauna in the area may be affected by mining areas and associated infrastructure, due to these areas forming a barrier to migrating animals (waste facilities) or reducing the chance of an animal surviving its migration due to collisions with vehicles on the haul roads.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, negligible following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Barriers created by linear infrastructure impeding local migration of fauna.

Nature of impact

Assessment Methods

The nature of this impact was determined through the evaluation of project infrastructure in relation to anticipated migratory pathways and access by fauna identified in the baseline study.

Mitigation

Mitigation can be achieved by the following methods:

- Linear infrastructure such as fences, roads and pipelines should be designed to incorporate culverts (fitted with drift fences) or access points to allow for local migration across linear infrastructure; and
- A low speed limit can be strictly enforced in order to reduce collisions with animals on the roads.

8.4.8 Biological Impact Number 6 - Increases in exotic and/or invader species

Features of impact

The impact of Increases in exotic and/or invader species may occur through all phases of the project. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Clearing of natural vegetation creates areas which may be colonised by exotic and/or declared invader species. Haul roads and trucks transporting material tend to spread propagatory material (seeds etc.) to these cleared areas thus increasing the chance of colonisation by exotic species. Anthropogenic (human) activities, may also create niches for exotic fauna (feral cats, domestic mice, Indian mynah and rats) which may outcompete or eat indigenous species.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Traffic and influx resulting in increases in exotic / invasive species of flora and fauna, affecting local habitats.

Nature of impact

Assessment Methods

An increases in exotic and/or invader species is most likely to take place on haul roads or other areas that are relatively sterile from an ecological point of view and this has been taken into account, through the adjustment of the intensity of the envisaged impact. Current levels of infestation as well as the number of exotic species currently existing in the area have also been accommodated in the impact assessment.

Mitigation

Mitigation can be achieved by the following methods:

- Minimising unnecessary ground clearing, which will create areas for colonisation;
- Reducing breeding and foraging areas for exotic species, by managing waste and dumping areas; and
- Monitoring exotic and/or invader species / vegetation and implementing a control programme for exotic and/or declared species, if necessary.

8.4.9 Biological Impact Number 7 - Degraded ecology from human presence

Features of impact

The impact of Increases in exotic and/or invader species may occur through all phases of the project. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Access to previously inaccessible areas could be a major impact when the mining is conducted on a large scale. Increased access allows the removal of native species for food, traditional medicines, or overutilization of natural resources by an increasing population. Potential influx of job seekers and development of informal residential and service areas close to the Project may increase the demand for ecological goods and services and increasing exotic and invasive species.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The activities associated with the Kamoa Copper Project that may potentially impact terrestrial species diversity, ecological integrity and important habitats include:

- Development of access roads resulting in increased access to previously inaccessible areas resulting in increased pressure on terrestrial habitats.

Nature of impact

Assessment Methods

The current levels of degradation due to overutilization were used as a benchmark for determining the possible impacts due to the unimpeded access to previously inaccessible areas.

Mitigation

Mitigation can be achieved by the following methods:

- Implementing an influx management strategy to proactively manage population influx to the area;
- Designating sensitive areas and avoiding placing infrastructure such as roads in these areas;
- Establishing measures to protect sensitive areas through community based natural resource management programs;
- Should roads need to be constructed, which will increase access to previously inaccessible areas, access to these roads can be restricted in order to prevent impacts in these previously inaccessible areas;
- Restriction of hunters, firearms and dogs on site will further prevent this impact;
- Erect manned boom gates fences and security check points where necessary; and
- Regular security patrols.

8.4.10 Biological Impact Number 8 – Degradation of Aquatic Habitats

Features of impact

The impact of Increases in exotic and/or invader species may occur through all phases of the project. The impact will be ***negative*** and the result of ***mining operations and the methods used in the mining process.***

Varying sediment size on the floor of aquatic habitats (i.e. substrate) and can determine both abundance and diversity of biota (i.e. stable sediment size has higher diversity and abundances; CBD, 2012). A mixed substrate typically has the highest variety of habitats and microflow patterns available for different biota, as different species invariably have differing habitat requirements. A pristine river represents a range of habitats for species with different preferences and life history strategies.

As outlined in Table 58, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an affect on the environment

Any change in aquatic habitat will effect in-stream biota. These changes, whether in habitat availability, quality or quantity may manifest from the following activities;

- Construction:
  - Disturbance and modification of stream channels;
    - Clearing of vegetation for infrastructure will expose soils that will be susceptible to erosion.
    - Earthworks in and around macro-channel will disturb bank stability and substrate. Exposed soils are vulnerable to erosion and runoff.
    - Removal or diversion of stream channel (including culverts).
  - Changes in downstream water flow;
    - Runoff from impermeable and cleared areas will increase volumes and velocities off water with little attenuation.
    - River crossings where culverts and bridges are required alter the flow dynamics and hydraulic units.
  - Changes in surface water quality;
    - Water from both ground and surface water that interacts with mining activities may enter the watercourses.
- Operation:
  - Disturbance and modification of stream channels.
    - Clearing of vegetation and earthworks (levelling) for infrastructure and mining activities.
    - Roads, conveyors and culverts.
  - Changes in downstream water flow;
    - Runoff from impermeable and cleared areas will increase volumes and velocities off water with little attenuation (Storm Water Management).
  - Changes in surface water quality;
    - Water from both ground and surface water that interacts with mining activities may enter the watercourses.
    - Operational spillages and onsite waste.
- Decommission:
  - Disturbance and modification of stream channels;
    - Earthworks for rehabilitation.
  - Changes in surface water quality;

  - Water from surface water that interacts with mining and rehabilitation activities may enter the watercourses.

- Post Closure:
  - Disturbance and modification of stream channels;
    - Remaining infrastructure such as TSF and Waste Rock Dumps may pose an issue through loss of catchment.
  - Changes in surface water quality;

Any potential contamination of groundwater or leachate from dumps

Nature of impact

Assessment Methods

Disturbance and modification of stream channels were determined using GIS analysis. The river network and infrastructure layouts (mine plan) were overlaid and assessed for potential crossings and disturbances.

Mitigation

The following mitigation measures will minimise the impact of habitat degradation:

Construction

- Avoid locating infrastructure in sensitive receptors and watercourses, taking surface runoff and wind direction into consideration. Avoid unnecessary disturbance to the riparian zones;
- Reduce uncontrolled runoff into streams. Appropriate silt traps should be installed to reduce velocities and further erosion. These will assist in settling out particulates before they enter the streams. Implement dust suppression where necessary (especially in the dry season). A note should be made as to the location of where the water for suppression is collected. This should incorporate protecting the streams from spills and pollutants.
- Reduce unnecessary clearing of vegetation and multiple access routes. Provide well marked access routes into exploration and construction areas;
- Restore vegetation in cleared areas so as to promote rehabilitation and stabilisation of topsoil. Rehabilitation efforts should incorporate appropriate contouring so that erosion is limited; and
- Monitor activities and spatial and temporal changes in aquatic habitat and biodiversity.

Operation

- Avoid sensitive receptors by controlling access;
- Manage silt traps and stormwater to reduce the significance of runoff entering streams. Continue dust suppression along roads and exposed areas;
- Ensure that base flow is maintained and that any water that is discharged or under the risk of spilling is of an acceptable quality;
- A spill response plan must be in place;
- Suitable liners must be incorporated into designs where storage of potentially hazardous materials will be stored.
- Continually rehabilitate exposed areas where possible; and
- Monitor activities and spatial and temporal changes in aquatic habitat and biodiversity.

8.4.11 Biological Impact Number 9 – Reduced diversity and abundance of Aquatic Fauna

Features of impact

The impact of reduced diversity and abundance of aquatic fauna may occur through all phases of the project. The impact will be ***negative*** and the result of ***construction and mining operations.***

Aquatic macroinvertebrates and fish communities are commonly used as indicators of river health as they respond quickly to changing environmental and physicochemical parameters. Different species have different habitat requirements and levels of tolerances that can be affected by flow velocity and depth classes, volume of flow, water quality, substrate, and cover. Alteration of these aspects typically creates shifts in community structure and overall abundances of biota. Any mine related activities that may alter the current state of the rivers thus has the potential to effect aquatic macroinvertebrates and fish diversity and abundances.

As outlined in Table 58, this impact is rated as negative, low prior to mitigation and negative, low following mitigation.

Nature of impact

Assessment Methods

The overall impact risk was determined by assessing the species present within the three rivers and the predicted alterations that may occur as a result of the mining activities within those areas

Mitigation

The following mitigation measures will minimise the impact on the abundance and diversity of aquatic biota (fish and aquatic macroinvertebrates):

Construction

- Any temporary structures such as culverts should make provision for fish migration and not inhibit flow; and
- Biomonitoring of fish and aquatic macroinvertebrate communities must be done to identify potential spatial and temporal changes. Due to the increased activity during construction and the influx of materials onto the site, it is recommended this be conducted quarterly.

Operation

- Design features must ensure that there is no impediment to fish migration; and
- Biomonitoring of fish and aquatic macroinvertebrate communities must be done to identify potential spatial and temporal changes. It is recommended this be conducted twice per year.

8.4.12 Biological Impact Number 10 - Loss and fragmentation of riparian and watershed grassland habitat

Features of impact

The impact of Increases in exotic and/or invader species may occur through all phases of the project. The impact will be ***negative*** and the result of ***construction and mining operations.***

General mining activities (including underground workings), clearing of areas for site access and infrastructure siting (including borrow pits and dams) can cause direct loss and fragmentation of riparian and watershed habitats through the following:

- Interception and confinement of surface runoff and seepage, leading to erosion and incision within the watershed grasslands and their existing drainage systems, as well as the creation of preferential flow paths which alter the natural flow pattern and in some cases direct storm water flow to the riparian areas and wetlands;

- Sediment mobilisation from the road; and
- Disturbance of the soil at the top of the catchments as these roads traverse the watershed. This removes the vegetation, loosens the soil and makes it more susceptible to erosion;
- Alteration to flow may ultimately impact on riparian habitat, and in some cases swamp forest and other wetland habitats associated with the watershed grassland in particular.

Exploration drilling may result in sludge and sediment deposition, oil, and lubricant contamination of the sites, and local changes in topography, all of which can cause localised loss of vegetation and biodiversity, particularly related to the pyrophyic watershed grassland habitats.

Ineffective housekeeping and handling and dumping of solid waste resulting in surface and sub-surface water contamination of wetlands, riparian habitats and pyrophytic watershed grasslands.

Contamination from underground workings and hydrocarbon spills and other hazardous waste chemical and/or product spills is likely to result in the contamination of surface and sub- surface water which in turn could either have direct impacts on affected wetlands, riparian areas and/or pyrophytic watershed grasslands. This could also have indirect effects on aquatic systems downstream or downslope

There is a risk of the release of polluted water from the TSF and pollution control dams which could contaminate the rivers and associated riparian areas and pyrophytic watershed grasslands

General disturbance and processes associated with the mining of copper are also expected to result in the deterioration of ecosystem functioning due to bio- accumulation of radio-active material, heavy metals and other pollutants in wetland and riparian systems. While certain wetland types may be able to trap and store some of these pollutants, the risk nevertheless exists that these effects could be detrimental to the ecosystem in general.

As outlined in Table 58, this impact is rated as negative, major prior to mitigation and negative, moderate following mitigation.

Operations that will have an impact on the environment

The following operations will have an impact on the environment:

- Construction of access roads;
- Exploration drilling;
- Clearing of areas for site access and infrastructure;
- Construction of borrow pits;
- Construction, operation and management of general infrastructure;
- Ineffective housekeeping;
- Placement of one pollution control dam;
- Storage and handling of hazardous materials and chemicals;
- Hydrocarbon spills and other hazardous waste chemical and/or product spills;
- Management and disposal of sewage and other non- hazardous/chemical liquid wastes;
- Placement of a raw water storage dam;
- Establishment of the stockpiles;
- Establishment of the TSF;
- Processes associated with the mining of copper; and

- Underground workings.

Nature of impact

Assessment Methods

The approach characterised wetlands associated with the proposed project through mapping, ecological functioning, importance and sensitivity, and the role they play in this regard at the local and more regional context. Mapping of the riparian zones was done to better understand the pattern of landscape hydrology and its interaction with abiotic and biotic components of the surface ecosystems.

Mitigation

Measures to remove and rehabilitate the temporary access roads and drilling sites should be put in place as part of an overall rehabilitation strategy for the mine.

All affected sites should be identified and a cleanup and rehabilitation plan should be implemented at these sites which should include as a minimum:

- The removal of the sludge and other waste drilling materials and oils from the sites;
- Reinstating the local topography; and
- Ripping of the compacted soil, and re-vegetation of the affected areas.

A monitoring programme should be put in place to ensure compliance with the rehabilitation plan and adequate recovery of the affected areas.

No heavy machinery should be allowed in watershed grassland, wetland or riparian systems unless specifically authorised and clear instructions pertaining to avoidance of impacts and compliance with the EMP are provided.

Permanent access roads must be appropriately designed for storm water.

All construction servitudes (excluding roads), including lay down, dam, TSF and stockpile areas should be fenced off and clearly demarcated.

Strategies for housekeeping should be implemented and waste must be removed to appropriate and approved landfills. Recycling should be encouraged and staff and contractors must be fined for littering or incorrect handling and management of waste (i.e. after relevant training is undertaken). A detailed management plan for handling of waste should be developed.

8.4.13 Certainty of Assessment

Due to the complex nature of ecological systems, it is not possible to conduct a study such as this with a very high confidence rating. That being said, experience allows experienced ecologists to confidently determine possible impacts before and after mitigation measures. An overall medium to high confidence is given to the prediction of impacts outlined above.

8.4.14 Biological Impact Assessment Summary

Table 59: Impact Assessment Summary

ID	Aspect	Phase / Timing	Impact Summary	Impact Characterisation – Prior to Mitigation												Impact Characterisation – post mitigation											
				Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	Probability of Occurrence	**Overall Risk (Magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility	Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	**Probability of Occurrence**	**Overall Risk (magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility
BIO 1	Terrestrial Ecology	Pre- Construction & Construction	Vegetation clearing	Neg	3	1	4	3	3	2.8	5	14	M	5	PR	Neg	2	1	2	3	3	2.2	2	4.4	M	5	PR
BIO 2		Pre- construction, construction, and operation	Contamination from harmful substances	Neg	4	1	2	3	4	2.8	4	11	M	2	ER	Neg	1	1	1	3	4	2	3	6	M	1	PR
BIO 3			Sensory disturbances from vibration and noise	Neg	3	1	3	3	3	2.6	4	10	M	4	ER	Neg	2	1	2	3	3	2.2	3	6.6	M	4	ER
BIO 4			Degraded ecology from reduced air quality	Neg	3	2	2	3	5	3	5	15	M	4	ER	Neg	2	1	2	3	2	2	4	8	M	5	PR
BIO 5			Local migration of animals	Neg	3	1	2	5	3	2.8	4	11	M	2	ER	Neg	1	1	2	2	3	1.8	2	3.6	N	2	PR
BIO 6			Increase in exotic and/or invader species	Neg	4	2	5	5	4	4	4	16	M	5	ER	Neg	2	1	2	3	2	2	3	6	M	5	PR
BIO 7			Degraded ecology from human presence	Neg	5	2	5	4	3	3.8	4	15	M	5	ER	Neg	1	1	1	2	2	1.4	3	4.2	M	5	I
BIO 8	Aquatic Ecology	Pre- construction, construction, and operation	Degradation of aquatic habitats	Neg	4	2	2	4	2	3	4	11	M	4	I	Neg	4	2	2	4	1	3	4	10	M	4	4
BIO 9			Reduced diversity and abundance of aquatic fauna	Neg	2	2	2	4	1	2	4	9	L	4	I	Neg	2	1	1	4	1	2	3	5	L	5	I
BIO 10	Wetland ecology	Pre- construction, construction, and operation	Loss and fragmentation of riparian and watershed grassland habitat	Neg	3	1	5	5	5	3.8	5	19	Maj	5	I	Neg	3	1	5	5	5	3.8	3	11.4	M	5	I

8.5 Sociological Environment

8.5.1 Impact Scoping

The proposed project (all components) are expected to give rise to the following social impacts, discussed in detail below:

- Physical and economic displacement of households;
- Employment opportunities;
- Opportunities for community development and skills development;
- Direct and indirect economic benefits related to capital expenditure, operational expenditure, fiscal impacts and salaries and wages;
- Population influx leading to increased demand for and pressure on land and natural resources;
- Increase in population and economic activity leading to impacts on institutions of governance, administrative capacity and the local and regional capacity to deliver basic infrastructure and services;
- In-migration of temporary construction and permanent workers;
- Impacts on community health due to population influx related to increased social pathologies;
- Impacts on community health caused by environmental impacts to air quality, water quality and noise;
- Impacts to community safety through increased traffic;
- Restriction and/or loss of access routes;
- Impacts on agricultural potential and livelihoods;
- Changes in cultural identity;
- Impacts to the costs of living due to inflation; and
- Increased potential for conflict.

8.5.2 Assessment Criteria

The specific assessment criteria used to determine the intensity of all sociological impacts was as follows:

Table 60: Socio-economic Assessment Criteria

Intensity		Extent	Duration	Value / Capacity of affected component	Risk to the human population	Probability	Frequency
Rating	**Socioeconomic**	**Al Disciplines**	**Al Disciplines**	**Socioeconomic**	**All Disciplines**	**All Disciplines**	**All Disciplines**
5 - Very high/ don't know	Significant change from baseline >50% change to indicator	5 – International/National (beyond Katanga Province **OR** trans boundary)	5 - Permanent / post closure	Extremely high value to society, academia, research or community OR No tolerance, acceptability or assimilative capacity for an impact by the community.	5 - Very high/don't know (Major loss of assets (>50%), or serious (life threatening) injury / health effect requiring hospital treatment, for an individual / community)	5 - Definite/don't know / >50% chance / definite / statistical evaluation based on discipline	5 - Continuous
4 - High	Visible change from baseline >25% and <50% change to indicator	4 – Provincial (Whole Lualaba Province)	4 - Long-term (>15 years and up to end of operations)	High value to society, academia, research or community **OR** Marginal tolerance and assimilative capacity for an impact by the community.	4 - High (Major loss of assets (>25%), or injury / health effect requiring hospital treatment, for an individual / community).	4 - Highly probable / >25% and <50% chance / statistical evaluation based on discipline	4 - Frequent (daily)
3 – Moderate	Detectable change from baseline >10% and <25% change to indicator	3 – Regional (Kolwezi District)	3 - Medium-term (>5 years and <15 years)	Moderate value to society, academia, research or community **OR** moderate tolerance and assimilative capacity for an impact by the community.	3 - Moderate (loss/injury/health effect on more than one local community) or <25% loss of assets for an individual/community)	3 - Medium probability / >10% and <25% chance / statistical evaluation based on discipline	3 - Medium-Frequency (once per week)
2 – Low	Detectable change from baseline >5% and <10% change to indicator	2 – Local (20km buffer around project)	2 - Short-term (<5 years)	Minimal value to society, academia, research or community **OR** high tolerance and assimilative capacity for an impact by the community.	2 - Low Minor (minor loss/injury/health effect to not more than one local community)	2 - Low probability / Possible under accidental conditions / >1% and <10% chance / statistical evaluation based on discipline	2 – Infrequent (once per Month)
1 – Minor	None / only slightly detectable change from baseline. <5% change to indicator (education health etc.)	1 - Site only i.e. Project infrastructure.	1 – Immediate then dissipates	No value to society, academia, research or community - as defined by consultation records **OR** Extremely high tolerance and assimilative capacity for an impact by the community.	1 - Minor (minor loss/injury/ health effect to an individual)	1 - Improbable (<1% chance of occurring, 1 in 100 years) / statistical evaluation based on discipline	1 – Infrequent (once per year

8.5.3 Sociological Impact Number 1 – Physical and Economic Displacement

Features of Impact

The impact of physical and economic displacement will occur ***pre-construction phase*** and potentially during the ***construction phase*** depending on project schedules. The impact will be ***negative*** and the result of ***all surface project infrastructure.***

For Kansoko mine an area of 7km^2 is planned to be fenced off for most of the planned surface infrastructure. This area was surveyed in 2016 and compensation made to individuals and communities for loss of crops, fields and access to this land. No physical resettlement is required for the Kansoko mine and no grave sites were identified inside the planned perimeter fence.

For Kakula mine, an area of 21km^2 is planned to be fenced off for most of the planned surface infrastructure. 45 Households were surveyed in this area in 2016 and a complete survey was made of all structures belonging to these 45 households. The resettlement compensation and process still needs to be determined in consultation with the affected people. In 2017 it is planned to complete a detailed survey of all fields inside the planned fence and to complete the compensation before construction of the fence. No grave sites were identified inside the planned perimeter fence for the Kakula mine, however one graveyard has been identified within the Kakula area directly above undergsound mining area, which may be affected by underground mining should subsidence occur.

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Physical displacement refers to relocation or loss of shelter. The project will incur physical displacement through the loss of homestead shelters and the relocation of households from the proposed project area to another (to be defined during resettlement planning).

Economic displacement refers to the loss of productive assets, usage rights or livelihood capacities because such assets / rights / capacities are located in areas required by the Project. Economic assets comprise land and various land covers (e.g., trees, food crops, cash crops and tree crops), which are held by households under customary tenures. The project will incur economic displacement through the loss of fields upon which the majority of households depend for income generation, either through crop cultivation or charcoal production, and through the loss of access to natural resources, which supplement household food supply, support medical needs, provide energy and water supply and provide traditional homestead construction materials . The scope of economic displacement is likely to comprise all those households to be physically displaced and a number of additional households with economic assets located in the Project area.

Resettlement research shows that displacement frequently results in the impoverishment of affected households and communities. Specific risks of resettlement include:

- **Landlessness**: the loss of landholdings will increase pressure on a households remaining land (if any) and other available land in the area. Landlessness is often the main form of impoverishment of displaced rural households;
- **Homelessness**: loss of shelter tends to be only temporary for many resettlers, but for some it will remain a chronic condition and may be felt as loss of identity and cultural impoverishment;
- **Marginalization**: households may lose economic power and be unable to use previously acquired skills in a new location, potentially leading to social marginalization and a decline in social status;
- **Food Insecurity**: resettlement can result in a decline in food availability and can affect arrangements for local food supply. The dependence on land for food supply has been noted in the baseline, as has the tendency for household food shortages which may be exacerbated by resettlement. The dependence on cassava as a staple food supply increases risks to food security for relocated households, as the crop is only ready for harvest three years after planting;
- **Loss of Access to Common Property and Services:** displacement can result in loss of access to forests, water bodies, burial grounds, sacred sites, as well as services such as health care and

education facilities, which have the potential to create deterioration in income levels and livelihoods; and

- **Social Disarticulation:** displacement can dismantle community structures and associations, family and other assistance group networks resulting in a loss of social capital, increasing the risks of impoverishment and social conflicts.

Risks relating to displacement are particularly high for vulnerable groups who are often without adequate income or family and community support to manage impacts of displacement, resulting in higher levels of impoverishment. Baseline data points to low income levels across the project area as well as a high percentage of population below the age of 15 and a number of female-headed households, indicating a potentially vulnerable status of many households that would need consideration during resettlement.

As outlined in Table 61, this impact is rated as negative, severe prior to mitigation and negative, major following mitigation and therefore will need particular focus and attention from management in the application of mitigation measures.

Operations that will have an Impact on the Environment

The following specific operations will result in physical and economic displacement:

- Fencing the Kakula and Kansoko mine areas and declaring these areas exclusion zones;
- Tailings Storage Facility Development;
- Powerline and road access development.

Nature of Impact

Assessment Methods

The impact of physical and economic displacement was determined based on the location of project infrastructure, preliminary indications of environmental impacts such as noise and air quality, and baseline data sourced from social surveys.

Mitigation

The following mitigation measures are recommended in order to address the impact of physical and economic displacement:

- **Avoid -** During the EIS update, site selection workshops have been held with environmental specialists, engineers and project planners in order to try and avoid the need for resettlement where possible through the siting of project infrastructure. Remaining requirements for resettlement are deemed necessary in order for the project to operate and to ensure the safety of surrounding communities;
- **Compensate** - Economic and physical displacement requires a separate resettlement plan that must take cognisance of the land-based livelihoods, social networks and the wider community structures. Preparation of a Resettlement Action Plan (RAP) is currently underway by Kamoa. This RAP will guide Kamoa and work to ensure that Project affected people, households, and communities are compensated fairly. Resettlement planning will include measures for households whose homestead structures fall outside of the project area, but whose fields or natural resources are within the project area, thus experiencing only economic displacement;
- **Enhance** – Given the land-based nature of livelihoods of Project Affected Persons, measures to improve and restore livelihoods should potentially include assistance with:
  - Acquiring access to grazing land, fallow land, forest, fuel and water resources;
  - Physical preparation of cultivation land;
  - Agricultural inputs such as seeds, fertilizer and irrigation;

- Small-scale credit or cash loans; and
- Access to markets, including transportation and information about market opportunities.

Opportunities for involvement in project employment should also be maximised. Although many of these positions will be skilled positions, the establishment of appropriate training and skills development at an early stage will allow local community members to benefit from such opportunities. An increase in wage-earning population would indirectly increase the demand for goods and services, potentially providing local business the opportunity to supply this demand, thus developing the local economy; and

- **Monitoring mechanisms** - The RAP will include detailed guidelines on monitoring impacts of displacement throughout resettlement implementation and the life of the project.

8.5.4 Sociological Impact Number 2 – Employment Opportunities

Features of Impact

The impact of employment opportunities will be largely ***positive,*** occurring during the ***construction, operations and closure phases*** of the project as discussed below, as a result of ***all project infrastructure***.

Current an dfuture project-generated employment is and will be both direct, positions that Kamoa will fill directly, and indirect, positions in companies contracted by Kamoa to provide goods and services to the project. Data collected during the 2013 and 2016 baseline studies indicates that education and skills levels are low amongst surrounding communities, meaning a high percentage of semi-skilled and skilled positions will need to be sourced from outside of the immediate project area, looking to district, provincial, national and finally international level. Benefits of project-generated employment will include an increase in formal wage employment, an increase in household wage levels and the standard of living, and increased economic activities created through increased income levels.

Although the creation of employment is largely positive, the impact entails certain risks. During consultation and social fieldwork, communities strongly expressed the need for jobs and to hire locals rather than ‘outsiders’, which will not always be possible given the skills levels required. Managing expectations relating to available employment opportunities through on-going consultation will be critical, as will managing perceptions relating to employment distribution between villages. Increasing formal employment will also have an impact on current livelihood strategies, potentially increasing pressure on remaining household members to undertake tasks. The employment of women may also impact gender roles, as women have been shown to have primary responsibility for children, food preparation and household tasks. Employment opportunities for specific project phases are outlined below:

- **Construction**

  Approximately 4000 additional employment opportunities, with an equal split between the Kansoko and Kakula Mine sites will be available during the construction phase, although exact figures for employment creation are unknown at this stage. However, it can be expected that opportunities will be available for unskilled and semi-skilled employment of the local population during the construction. Early management and planning during the construction phase will mean that opportunities for skills development and training may also be available during construction activities.

- **Operations**

  During operations commencing in 2019, between 1 750 and 2 250 will be employed across the two mine sites, providing long-term positive impacts. However, positions are more likely to require greater skills levels than currently found in local communities. Implementation of skills development programs will maximise opportunities for local communities.

- **Decommissioning / Closure**

  The availability of employment opportunities is likely to temporarily increase during decommissioning activities, with potentially higher numbers of unskilled positions available, benefiting local communities. However, closure will result in the lay-off of employees, reducing formal employment opportunities, income levels and potentially changing livelihoods strategies. Given the historical high reliance on mining for livelihoods in the region and the significant negative impacts associated with the closure of Gecamines, the sensitivity of the local social environment to closure of mining operations is high. However, given the current development of multiple mining projects within the Kolwezi area, it is anticipated that the magnitude of this impact will be lessened as some employees should be able to find employment at other mines. Ultimately, however, loss of employment will occur for a substantial number of employees of the proposed project.

As outlined in Table 61, this impact is rated as positive, low prior to mitigation and positive, moderate following mitigation.

Operations that will have an Impact on the Environment

All Kamoa construction and operational activities will require employees therefore all activities apply to this impact.

Nature of Impact

Assessment Methods

Assessment of the impact of employment opportunities took into consideration current levels of formal employment, livelihood strategies and income levels amongst local communities, data regarding skills availability, and information sourced from community consultation records.

Mitigation

- **Enhance -** In order to maximise potential employment opportunities and reduce risks outlined above, Kamoa has developed a policy to maximise local, regional, and national participation in the direct and indirect employment opportunities generated by the Project. The aims of the policy are to:
  - Engage with relevant stakeholders to ensure employment is fairly and evenly distributed;
  - Develop a local labour pool of qualified local workers;
  - Develop a skills transfer and human resource development strategy to ensure up-skilling of local employees throughout the project life; and
  - Develop a local contractor pool and employment strategy to maximize indirect employment.

  The policy also focuses on skills training and education programs for the local population to promote development and increase local capacity. Such training will assist during the closure and post-closure phases of the project when workforce is laid off, as employees will have greater opportunities for alternative employment.

  Training and education programs work alongside programs identified in the Sustainable Development Plan (SDP).

- **Monitoring mechanisms** - Monitoring mechanisms for the impact of employment opportunities will include bi-annual audits of recruitment and employment mechanisms, the status of the workforce, and development and continuation of skills development programs throughout the project life.

8.5.5 Sociological Impact Number 3 – Community Development

The project has the potential to benefit affected communities through the implementation of community development programs. Kamoa are currently supporting communities through agricultural support and development. Kamoa has established Community Development Committees (CDC) in villages to ensure participation of residents in the scheme and sustainability of projects. The need for development is reinforced by the large number of comments received during community consultation highlighting the need for development, including assistance with water supply, schools, health care, roads and transport. Developmental support based on community consultation, research on similar community development projects and a plan identifying long term goals can significantly improve the quality of life of households.

Regionally Ivanhoe Mining, Kamoa's parent company, is providing support to the DRC's National Malaria Control Program (PNLP). Ivanhoe in collaboration between Fio, Chemonics and the Ministry of the Health are supporting activities under the PNLP in 300 healthcare facilities over three years in Haut-Katanga and Lualaba Provinces. The support specifically involves the roll out of Fionet, a solution developed by Fio to help frontline health workers improve the quality of care that they deliver to individual patients while automatically capturing data that is critically needed to strengthen health systems as a whole. The data that the Ivanhoe-Fio Project captures will help provincial and national governments strengthen disease surveillance and the management of malaria control activities in the DRC.

The impact of community development will occur throughout the ***construction and operations phases.*** The impact will be ***positive*** and will be the result of ***all project infrastructure***. During decommissioning and closure of the mine, support for community development initiatives will necessarily decline, potentially having a negative impact on development. However, with the implementation of a Community Development Plan focusing on sustainable, long-term development, initiatives can have a permanent positive impact on communities, continuing post closure.

As outlined in Table 61, this impact is rated as positive, low prior to mitigation and positive, moderate following mitigation.

Operations that will have an Impact on the Environment

All activities and operations will have an impact on community development as they will all be required for income generation. The activities of the corporate social responsibility department will directly influence the extent of community development success.

Nature of Impact

Assessment Methods

Assessment of the impact of community development took into consideration current levels of income, access to services such as potable water, sanitation, education and health care, livelihood strategies, and food supply as well as community comments regarding development needs and Kamoa's commitments to community development.

Mitigation

- **Enhance** – A Sustainable Development Plan has been developed drawing on information gathered through community consultation, social and environmental baseline data, local, regional and national development plans and agendas, and previous community development projects to devise a strategy by which to undertake community development. The plan includes aspects such as skills and education, health, and social infrastructure and will focus on key areas and targets throughout the project life. Monitoring measures with key indicators are included to assess the effectiveness of programs in achieving sustainable, long-term development.
- **Monitoring mechanisms** - Monitoring mechanisms for the impact of community development include monthly reports of community development activities, minutes of meetings held with Community Development Committees, and annual audits of commitment outlined in the SDP.

8.5.6 Sociological Impact Number 4 – Economic Benefits

The impact of increased economic revenue will be a ***positive impact*** occurring during the ***construction and operations phases*** of the project as a result of ***all project infrastructure***.

On a local and regional level, the project will generate new demand for goods and resources. Direct project needs will generate significant demand for supply of various construction materials, fuel, energy, as well as food and other personal items for project employees. Indirectly the project will create additional demand for goods and services as elevated employment levels result in increased spending levels and disposable income. Increases in population, from both the direct and indirect project workforce and an anticipated influx of population attracted by potential project opportunities will also increase demand for goods, presenting potential business opportunities.

On a regional and national level, the project will increase government revenue, through the payment of taxes by Kamoa SA and through increased taxable transactions and income. Increased revenue would likely positively impacting citizens on a regional scale. The Project is likely to raise national Gross Domestic Product (GDP) by more than current onsite economic activities (agriculture) would over the same period. The GDP that will be produced as a result of the mine's operational expenditure should far outweigh agricultural expenditure that would occur in the event that the project is not implemented.

A number of factors could however affect the full realisation of the expected positive economic impacts. These include:

- Importation of capital goods and consumables - will reduce the expected increase in national GDP;
- Use of foreign labour - will reduce the expected increase in national employment and consequently household income;
- Damage to roads used for transporting agricultural and other goods to market – may reduce GDP from non-mining activities close to the project site; and
- Failure to successfully relocate agricultural activities to fully compensate for income lost as a result of relocation – will reduce GDP, employment, and income, however, the impact is likely to be small and spatially restricted.

As outlined in Table 61, this impact is rated as positive, moderate prior to mitigation and positive, moderate following mitigation.

Operations that will have an Impact on the Environment

All activities and operations will have an impact on economic benefits as they will all be required for income generation.

Nature of Impact

Assessment Methods

The assessment of economic impacts took into consideration data regarding employment and income levels amongst local communities, DRC legislation regarding payment of taxes and observations regarding development needs in Kolwezi.

Mitigation

- **Enhance -** To ensure that the positive macroeconomic impact created by the project is as large as possible, the following mitigation measures are proposed:
  - Procure capital goods and consumables locally;
  - Use local labour as far as possible;
  - Ensure that roads used by locals for transporting goods and services to market are not damaged by the project activities;
  - Adequately compensate local people for the loss of crops and dwellings due to mine development ; and
  - Assist in ensuring the success of the spatial transfer of agriculture.
  - Continue with the employment policy including skills development programs will maximise direct and indirect employment opportunities, increasing the potential for induced economic benefits of the project.
  - The SDP can also improve the potential for sustainable and diversified economic development and growth through support for alternative services, having significant benefits upon closure of the mine.

- **Monitoring mechanisms** - Monitoring of the Employment Policy implementation will assist in monitoring induced economic impacts. Further monitoring activities will be achieved through population and demographic surveys to assess the employment status and income levels of households.

8.5.7 Sociological Impact Number 5 – Increased Demand For and Pressure on Land and Natural Resources

The project will lead to population growth, through an in-migration of project employees, and through an in-migration of opportunity seekers. Restrictions to land caused by the project infrastructure requirements combined with a population influx and increased demand for food supplies may increase demands for land and natural resources in the project area. This impact will be ***negative***, will occur during ***the construction, operations and decommissioning phases*** of the project and will be the result of ***all project infrastructure***.

Subsistence agriculture is the primary livelihood base and source of income for the majority of households in the project area and a large proportion of the population are dependent on natural resources for drinking water, food supplements, income generation, energy supply, and building materials. Increased population combined with project restrictions to land will increase pressure on these natural resources, potentially affecting the ecosystem balance and resulting in shortages of water, food, energy, and building materials as well as impacts to the quality of these resources.

As outlined in Table 61, this impact is rated as negative, major prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for population growth and thus increased pressure on natural resources.

Nature of Impact

Assessment Methods

Assessment of impacts to the demand for and pressure on land and natural resources takes into consideration professional experience and documented research of population influx associated with large-scale mining projects combined with baseline data regarding usage and dependency on land and natural resources.

Mitigation

- **Reduce** - Impacts can be reduced through the development of measures aiming to minimise population influx, such as access routes and control, project buffer zones, worker housing and transport, workforce recruitment policy and management, and procurement of goods and services away from the mine areas.

  Pressure on land and natural resources can also be reduced through the SDP in considering alternative livelihood strategies and skills development to provide alternate income sources and reduce dependency on land;

- **Monitoring mechanisms** - Monitoring of population demographics including population size, household size and age and gender breakdown will assess population influx.

  Monitoring of populations livelihood strategies, skills levels and income levels will also assist in assessing the effectiveness of the Community Development Plan and goals to promote alternative livelihoods and income sources.

8.5.8 Sociological Impact Number 6 – Pressure on Basic Services and Infrastructure

The population growth described above will increase pressure on already limited basic services and infrastructure, including education facilities, health care facilities, water, sanitation and waste disposal facilities. This impact will occur during the ***construction, operations and decommissioning phases*** of the project, will be ***negative***, and will be the result of ***all project infrastructure***.

The few facilities that do exist within the project area are largely in poor condition with insufficient capacity or equipment, and in the case of education and health care, already over-capacity. Potable water supply is limited, with a large proportion of households commenting about lack of water during the dry season. Sanitation and waste disposal facilities are rudimentary or non-existent. Government facilities are also limited; a small police station exists in Musokantanda, otherwise services are in Kolwezi, suggesting limitations to the management of a potential increase in crime. An increase in population will further exacerbate the shortfall in social services. This is especially the case given potential project water requirements.

Impacts to basic services are likely to continue throughout the construction and operations phase. During closure it is likely that there will be a gradual movement away from the project area, easing pressure on available services.

As outlined in Table 61, this impact is rated as negative, major prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for population growth and thus increased pressure on services.

Nature of Impact

Assessment Methods

Assessment of impacts to basic services and infrastructure was based on data regarding the current availability of services, household level usage of such services and experience regarding population influx as noted above.

Mitigation

- **Reduce** - The impact of pressure on basic services and infrastructure can be reduced through the implementation of an Influx Management Plan to reduce the increase in population as noted above. Incorporation of service development in the Community Development Plan will also assist with managing pressure on services and improve capacity through the development of additional educational, health, water, sanitation and waste disposal facilities in local communities where possible;

- **Monitoring mechanisms** - Annual monitoring of population demographics including population size, household size and age and gender breakdown will assess population influx. The Influx Management Plan will also include monitoring measures to assess the timely implementation of identified procedures.

  Annual monitoring of access to basic infrastructure including school attendance, educational attainment, water and sanitation supply and health indicators will also assist in assessing the effectiveness of the Community Development Plan and goals to support infrastructure development.

8.5.9 Sociological Impact Number 7 – In-Migration of Workers: Camp

The need for an external workforce due to project skills requirements has been noted. Given the lack of existing housing and infrastructure, a construction camp will be installed to house employees at both Kakula and Kansoko. Such a camp may increase induced economic benefits through the demand for goods and services for both the camp operation (cleaners, cooks, maintenance etc.) and through workers demand for commercial facilities.

However, the construction camps may also result in negative impacts to community health. Experience has shown that the construction of a camp often leads to the creation of an informal service centre in close proximity to the camp, particularly for drugs and alcohol, increasing the possibility of substance abuse. An increase in prostitution may also follow as employees have increased disposable incomes attracting economically vulnerable women. Given the lack of health care facilities or knowledge, it is likely that this may lead to an increase in sexually transmitted diseases, including HIV/AIDS.

The impact of an in-migration of workers in a construction camp will occur during ***the construction, operation and decommissioning phases*** of the project. The impact will be ***negative*** and will be the result of ***all project infrastructure.***

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

All Kamoa construction and operational activities will require employees therefore all activities apply to this impact.

Nature of Impact

Assessment Methods

Assessment of the impact of a construction camp is based on previous project experience, the levels of poverty noted in local communities, the existence of vulnerable households, and the lack of community health facilities to manage such impacts.

Mitigation

- **Reduce** – Impacts relating to the establishment of a construction camp can be reduced through a number of measures. The design of a construction camp needs to meet specific standards in terms of space and facilities and include sufficient activities and equipment to ensure normality for workers as far as possible, providing entertainment in order to reduce the need to seek alternatives. The creation of buffer zones and access control will restrict the potential for development of informal service centres. Employee health awareness campaigns and provision of medical facilities will also assist in reducing health-related impacts;

- **Enhance** – Implementation of the Employment Action Plan and Community Development Plan (discussed above) will maximise opportunities for induced economic impacts relating to the construction camp; and

- **Monitoring mechanisms** – Monitoring mechanisms to address impacts relating to a construction camp will include auditing of the construction camp design and operation, access control procedures audits and regular monitoring of health awareness campaign provision and attendance.

8.5.10 Sociological Impact Number 8 – Community Health: Influx

Increased in-migration and rapid social change is often associated with an increased risk of contracting infectious diseases, including sexually transmitted diseases such as HIV/AIDS. As with the construction camp, the potential exists for increased substance abuse and prostitution impacting community health. Other infectious diseases may include tuberculosis, measles, flu, etc. An increase in vector-borne diseases may also occur as migrants bring in parasites which are then transmitted to the local population, as well as health risks from poor water quality, sanitation and waste disposal facilities, again exacerbated by an increased population. As previously noted, current capacity constraints in health care facilities will increase risks relating to the spread of diseases.

Impacts to community health related to population influx will be ***negative***, will occur during the ***construction, operations and decommissioning phases*** of the project, and will be the result of ***all project infrastructure***.

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for population growth and thus increased pressure on health services and increased risk of communicable diseases.

Nature of Impact

Assessment Methods

Assessment of the impact of influx on community health is based on previous project experience, the anticipated levels of influx, the levels of poverty noted in local communities, the existence of vulnerable households, and the lack of community health facilities to manage such impacts.

Mitigation

- **Reduce** – Impacts to community health as a result of population influx can be reduced through the implementation of an Influx Management Plan and Community Development Plan as noted above. Particular focus should be on improving availability of health care facilities to the rural population, taking into consideration access issues. Improved availability of medicines and qualified staff in health centres is also needed, as is knowledge regarding the spread and management of diseases. Kamoa should continue working with local government or NGOs in order to implement such a scheme, potentially having regional benefits;
- **Monitoring mechanisms** – Annual monitoring of community health levels and knowledge regarding diseases through social surveys and collection of health data. Audits of health care facilities including presence of health care professionals, availability of medical supplies.

8.5.11 Sociological Impact Number 9 – Community Health: Environmental Factors

Project activities during the ***construction, operation and decommissioning phases*** are likely to create a number of ***negative*** environmental impacts affecting air quality, noise levels and quality and quantity of water. Specific impacts relating to key project infrastructure components during particular project phases are addressed in Section 8.3. Increased dust levels, increased noise levels, and potential contaminants in water may all contribute to a decline in community health levels and increased risk of illness and disease. This is particularly relevant considering the relatively low health status of many communities due to poor diet and nutrition and lack of access to medical facilities.

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The combined operation will result in specific biological and physical impacts (as defined in Section 8.3 and 8.3.17).

Nature of Impact

Assessment Methods

Assessment of impacts to community health relating to environmental impacts was based on specialist assessment of impacts in relevant environmental studies combined with data on existing health levels and health infrastructure in the project area.

Mitigation

- **Avoid –** Where possible, mitigation measures will be implemented to avoid environmental impacts, such as the creation of buffer zones, dust-suppression measures, maintenance of project equipment and operation during daylight hours, creation of noise barriers etc;
- **Reduce** – In cases where it is not possible to avoid environmental impacts, measures will be implemented to reduce impacts as far as possible, as described in the biophysical studies reports;

- **Compensate** – The Community Development Plan will include measures to improve health care facilities which will assist in addressing community health care problems. Investigation into providing potable water supply will also be undertaken to address potential impacts to water quality and quantity caused by the project and to improve the existing standard of potable water;
- **Monitoring mechanisms** – Monitoring mechanisms to address environmental impacts have been outlined in relevant specialist studies. Annual monitoring of community health levels and knowledge regarding diseases through social surveys and collection of health data.

8.5.12 Sociological Impact Number 10 – Community Safety

The project will entail increased traffic of heavy goods vehicles, mine vehicles, traffic relating to goods and services, and workforce transport. Road networks within the project area are gravel or dirt and in relatively poor condition, and Kamoa SA will develop a new access road from both mine areas to Kolwezi airport. Increased traffic is likely to increase the potential for traffic accidents. The presence of vehicles within the project area is currently extremely limited with the majority of the population accessing services on foot via the main roads / tracks. The high numbers of pedestrians on the roads combined with limited road traffic awareness and poor road conditions will increase the risk of traffic accidents.

Community safety risks will also occur due to project activities, including through the operation of heavy machinery, and mining activities (particularly underground mining which may result in surface subsidence).

Impacts to community safety will occur during the ***construction, operations and decommissioning phases*** of the project. The impact will be ***negative*** and will be the result of ***all project infrastructure.***

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The key activities applicable to this impact are access road use and potentially caving as a result of underground operation near sensitive locations.

Nature of Impact

Assessment Methods

Assessment of the impact of increased traffic to community safety took into consideration project information relating to the estimated traffic figures, site observations relating to the existing condition and use of roads, and community consultation records indicating concerns over increases in traffic, and extent of mining areas and their location with regard to sensitive receptors.

Mitigation

- **Reduce** – A Health and Safety Plan is currently in operation at Kamoa, which will be further developed into a Community Safety and Security Plan. It is recommended that this is developed to include risks relating to all project phases. The plan will include guidelines regarding recommended speed limits on roads and through villages for all vehicle types, with speed bumps constructed in key areas of concern. Drivers should be provided with health and safety training regarding the potential risks of travel and training to navigate difficult road conditions, including areas affected by sand, rocks or rain. Vehicles should be regularly checked and maintained to reduce the potential for accidents.

  Exclusion zones will be established to ensure access to mining areas is restricted to required, qualified personnel only in order to prevent safety risks to community members. Details of specific measures will be included in the Community Safety and Security Plan.

  During ongoing consultation activities, communities will be provided with health and safety information. Training should specifically target children, with information available in schools and public places. Information should include details of how to respond and assistance available should accidents occur;

- **Monitoring mechanisms** – Monitoring activities will include monthly audits of accidents and community grievances relating to traffic, bi-annual audits of training and health and safety information provided to drivers, and regular checks of drivers to ensure guidelines are being followed. Monitoring will also include assessment of community awareness of traffic, included in annual community surveys.

8.5.13 Sociological Impact Number 11 – Restrictions to Access Routes

Proposed project infrastructure and exclusion zones will create restrictions to existing access routes used to access health and education services, to access Kolwezi in order to sell agricultural products and charcoal and to buy goods, and to access family or friends in other villages. Given the limited social services available, the dependence on Kolwezi in order to generate income and the predominance of access on foot rather than other forms of transport, access restrictions could have significant consequences on livelihoods of households within and surrounding the project area. Conversely the new road that will be opened from the mine areas to Kolwezi could provide improved access to the eastern side of Kolwezi.

Impacts to access routes will occur during the ***construction, operations and decommissioning phases*** of the project. The impact will be ***negative*** and although certain components will affect certain access routes, the overall impact and project exclusions zone will mean the impact will be the result of ***all project infrastructure***.

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The fencing of the Kansoko and Kakula areas will be the key project aspect that will result in restrictions to access.

Nature of Impact

Assessment Methods

Assessment of the impact of restricting access routes was based on data collected during surveys relating to services used by households and mapping of access routes to determine those most frequently used.

Mitigation

- **Compensate** – Where access routes are affected, alternative access needs to be provided without increasing the effort or time needed to travel. In the case of households to the south accessing services in the north, the possibility of support the improvement or development of additional services should be explored in line with the Community Development Plan;

- **Monitoring mechanisms** – Use of services, time taken to access services and transport routes used should be included in annual social surveys across the project area in order to monitor the effectiveness of alternative access routes and new services available.

8.5.14 Sociological Impact Number 12 – Change in Livelihood

The project has the potential to change livelihoods in the project area, moving communities away from subsistence agriculture as the predominant livelihood of residents. A number of factors will contribute to this change:

- The project will generate employment and induce economic activities which may lead to greater participation in the formal economy and higher disposable incomes;

- The project will entail restrictions to land availability due to population influx and land requirements of the project, putting pressure on available resources; and

- The project may result in impacts to soil and water quality changing required cultivation patterns, the ability to grow certain crop types, or the ability to achieve certain crop yields. The outcome of these impacts may result in changes to current livelihood strategies and customs. Dependence on subsistence agriculture as a main livelihood strategy may no longer be possible.

Changes to livelihood strategies may particularly impact vulnerable households who are unable to adapt and cope with sudden changes, leading to increased levels of impoverishment.

Changes in livelihood strategies will occur during the ***construction, operations and decommissioning phases***. The impact will be ***negative*** and will be the result of ***all project infrastructure.***

Following project ***closure***, there will be a decline in employment opportunities and a reduction in land restrictions. However, it is unlikely that land will be of the same quality as before mining and therefore suitable for similar crop cultivation. Livelihood strategies will no longer be supported by project activities and will therefore return to subsistence agriculture or other alternatives, potentially drawing on skills and community development programs implemented during project operation.

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, moderate following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for this change.

Nature of Impact

Assessment Methods

Assessment of the impact of change on livelihood strategies took into consideration baseline data regarding current livelihood strategies, figures relating to project employment and experience relating to population influx.

Mitigation

- **Reduce** – A change in livelihood strategies is inevitable to a certain degree in large scale mining projects. Negative impacts associated with such a change can be reduced through:
  - Implementation of the Employment Action Plan in order to maximise opportunities and distribute employment benefits as evenly as possible across affected communities;
  - Implementation of a Community Development Plan, focusing on supporting alternative livelihood strategies and developing agricultural practices; and
  - Implementation of a Resettlement Action Plan including Livelihoods Restoration Plan as outlined above.
- **Monitoring mechanisms** – Monitoring mechanisms will include those already outlined for the Employment Action Plan, Community Development Plan, and Resettlement Action Plan.

8.5.15 Sociological Impact Number 13 – Change in Cultural Identity

The project will lead to rapid changes in the social environment linked to population influx, the changing economy, and changes in livelihood strategies. Such changes will particularly be felt by households experiencing physical and economic displacement. The breakdown of existing social networks may result in a weakened social fabric, both for those displaced and those remaining in existing homesteads. Such changes may create uncertainty for households, affecting residents differently depending on their perceived ability to access project benefits and community support structures. Change and uncertainty may lead to a loss of cultural identity and sense of belonging in the community.

Changes in cultural identity are likely to occur during the ***construction, operations, decommissioning and closure phases*** of the project. Project closure may reduce some sources of uncertainty, but will likely introduce additional sources, including unemployment, deflation, and population out-migration. The impact will be ***negative*** and the result of ***all project infrastructure.***

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for this change.

Nature of Impact

Assessment Methods

Assessment of the impact of change in cultural identity took into consideration baseline data regarding the existing economic, current livelihood strategies, figures relating to project employment and experience relating to population influx.

Mitigation

- **Reduce** – Impacts to cultural identity can be reduced through implementation of a Stakeholder Engagement Plan to ensure communities are aware of all project changes, reduce uncertainty amongst communities and allow participation in project decision-making. Kamoa can also consider supporting local communities to develop a cultural centre to promote cultural heritage, support traditions and provide a forum for future cultural interactions. A grievance mechanism should be put in place to resolve grievances raised by the local community.

- **Monitoring mechanisms** – Monitoring mechanisms will include those already outlined for the Stakeholder Engagement Plan. Implementation of a cultural centre will also be reviewed to assess the effectiveness of the scheme.

8.5.16 Sociological Impact Number 14 – Inflation

Project-induced economic activities and population growth will lead to an increase in prices for goods and services. This will occur during the ***construction, operation and decommissioning phases*** of the project, will have both ***positive and negative*** consequences and will be the result of ***all project infrastructure***.

As previously noted, the project will increase demand for land, food supplies and services, as a result of increased population. Increasing pressure on existing supplies will increase prices, resulting in inflation. For venders, this will have a positive impact to businesses, however, consumers will experience negative impacts as the cost of living increases and quality of life potentially decreases.

As outlined in Table 61, this impact is rated as negative, moderate prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for this change.

Nature of Impact

Assessment Methods

Assessment of the impact of inflation was based on experience relating to population influx, data regarding existing food and service supply and previous project experience.

Mitigation

- **Reduce** – Support the development of small businesses to increase supply of goods and services and avoid escalating costs due to limitations in supply;

- **Compensate** – Should monitoring activities discussed below reveal increasing hardships for vulnerable households as a result of inflation, it is recommended that Kamoa provide assistance through measures identified in the Community Development Plan;

- **Monitoring mechanisms** – Monitoring measures will include annual monitoring of market food prices, and assessment of national inflation levels. Annual social surveys will include questions relating to food shortages and income levels in order to determine the quality of life of local residents.

8.5.17 Sociological Impact Number 15 – Increased Potential for Conflict

Project-related activities and associated impacts have the potential to increase conflict within the project area. This could be as a result of increasing population or existing ethnic tensions between the two chiefdoms affected by the project. This impact may occur during the ***construction, operations and decommissioning phases***, will be ***negative***, and will be the result of ***all project infrastructure***.

During consultation activities, tension has been noted between the chiefdoms of Musokantanda and Mwilu. Both chiefdoms want equal representation in the project to ensure equal receipt of project benefits. Consultation activities have been carefully planned in order to address both chiefs concurrently to avoid the perception of inequality and Kamoa have sought to involve both chiefs in project activities and planning wherever possible. Ongoing engagement with the chiefs by Kamoa have managed to reduce this perception. Conflict may also occur due to increased population with tensions between 'locals' and 'outsiders'. These may relate to access to employment and the 'rights' of local residents to employment opportunities, pressure on social services and reduced capacity of these given population growth, and changes to cultural patterns, including language, and behaviours, relating to an increase in social pathologies described above.

As outlined in Table 61, this impact is rated as negative, low prior to mitigation and negative, low following mitigation.

Operations that will have an Impact on the Environment

The combined operation will likely be a key driver for this change.

Nature of Impact

Assessment Methods

Assessment of the potential for conflict took into consideration consultation records and reports and experience relating to population influx associated with such projects.

Mitigation

- **Reduce** – The potential for conflict will be reduced through ongoing consultation activities in line with the Stakeholder Engagement Plan to ensure transparency and understanding of all project activities. Ongoing involvement of Chief Mwilu and Chief Musokantanda in project activities and decisions where possible will assist with spreading consultation messages and reduce the potential for ethnic conflicts relating to perceptions of unequal involvement in the project. Communication of the Employment Action Plan and Community Development Plan will ensure that communities are aware of project procedures and measures to address issues such as employment distribution and development to reduce pressure on services.

  Kamoa could explore the possibility of working with local communities and stakeholder to develop a cultural centre to promote cultural heritage (discussed above) within the project area and to ensure 'outsiders' are aware of cultural traditions and acceptable behaviour. New employees from outside the project area can learn about traditions and be presented with a Code of Conduct outlining correct procedures;

- **Monitoring mechanisms** – Monitoring mechanisms will include monthly assessments of consultation activities and meetings held and an annual audit of the implementation and update of the Stakeholder Engagement Plan. Implementation of a cultural centre will also be reviewed to assess the effectiveness of the scheme.

8.5.18 Sociological Impact Number 16 – Impact on Cemeteries

Cemeteries might be impacted negatively by any of the following phases of the Project.

- Construction
  - Relocation of cemeteries – one graveyard has been identified within the Kakula area and one grave has been identified along the proposed access road that will need to be relocated;

  - Accidental destruction or access – Project employees could accidentally access cemeteries which is considered to be blasphemy by local communities.
- Operations
  - Subsidence might affect cemeteries;
  - Contractors - Project employees could accidentally access cemeteries.
- Decommissioning / post closure
  - No impact on cemeteries.

As outlined in Table 61, the impact is assessed as major prior to mitigation and moderate following mitigation.

Operations that will have an Impact on the Environment

Underground operations at Kakula will be directly under the identified cemetery and due to the risk of subsidence will need to be relocated. Other mining areas and land clearance for project infrastructure may further result in accidental impacts to unidentified burial sites.

Nature of Impact

Assessment Methods

The assessment took into account the project layout and the location of identified burial sites.

Mitigation

- **Avoidance measures –** Relocation of cemeteries should be avoided where possible to avoid negatively impacting social beliefs and practises. All cemeteries in the areas should be identified, surveyed and clearly marked on maps and in the field where culturally appropriate to do so. Project infrastructure should be sited where possible so that it does not affect any identified cemeteries. All employees, contractors, subcontractors and consultants should be sensitized and inducted on archaeology and cultural heritage prior to starting any field work and any other discovery should be reported to the management.
- **Reduction measures** – During detailed design and the Resettlement Action Planning (RAP), the recommendations from the Resettlement Action Plan (RAP) should be taken into consideration. Project infrastructure should be sited to avoid impacting local cemeteries where possible to reduce the extent of the impact on local communities.
- **Restoration measures –** should cemeteries need to be relocated, Kamoa should follow both DRC legal and local custom and practice as defined through extensive engagement with local communities. All legal procedures and local customs must be followed as defined in the RAP.
- **Compensate** – Any compensation must be determined through the RAP.
- **Enhance** – None

Monitoring mechanisms – detailed monitoring measures for the relocation of cemeteries will be defined in the RAP. Monitoring should include regular engagement, visual records (photos), and documentation to verify the process of relocation of cemeteries. A grievance mechanism should be put in place to resolve grievances raised by the local community. Procedures for addressing any non-conformances should be defined in the RAP.

The overall Environmental and Social Management System (ESMS) should include induction and induction tracking for employees, contractors and visitors relating to archaeology and cultural heritage.

8.5.19 Sociological Impact Number 17 – Impact on Sacred Sites

The sacred sites (trees, rivers and waterfalls) identified within the Project footprint are unlikely to be impacted by project activities as they are not located within the footprint of any of the proposed infrastructure.

Negative impacts could occur should site clearance and project development be undertaken on unknown / unidentified sacred sites. Impacts are likely to occur only during the construction Phase of the Project i.e. due to site clearance which would result in the destruction or alteration of sacred sites. There may be a risk that the households that would need to be resettled may have specific (local / village level) sacred sites that may be impacted on by Project development.

Construction and operational personnel could unintentionally cause offence to local communities if sacred sites are visited, talked about or published without observing local custom and practice.

As it is unlikely that sacred sites will be impacted by Project activities as outlined in Table 61, this impact is rated as low prior to mitigation and negligible following mitigation.

Operations that will have an Impact on the Environment

Mining areas and land clearance for project infrastructure may further result in accidental impacts to unidentified sacred sites.

Nature of Impact

Assessment Methods

The assessment took into account the project layout and the location of identified sacred sites.

Mitigation

- **Avoidance measures –** All specific sacred sites should be identified, surveyed and clearly marked on maps and in the field where culturally appropriate to do so. All employees, contractors, subcontractors and consultants should be sensitized and inducted on archaeology and cultural heritage prior to starting any field work and any other discovery should be reported to the management.
- **Restoration measures** – Should sacred sites be impacted (as identified during the RAP process or during construction activities), Kamoa should negotiate with local communities appropriate restoration measures.
- **Compensation measures** – Should sacred sites be impacted (as identified during the RAP process or during construction activities), Kamoa should negotiate with local communities appropriate compensation measures.
- **Monitoring mechanisms -** A grievance mechanism should be put in place to resolve grievances raised by the local community.

Kamoa should ensure that induction and induction tracking is undertaken for employees, contractors and visitors relating to archaeology and cultural heritage.

8.5.20 Sociological Impact Number 18 – Accidental destruction, removal or covering of archaeological or cultural artefacts

From the baseline studies, one site KM75 is located within the proposed plant area and therefore additional Stone Age artefacts could be uncovered during site clearance in this area. Due to the limitations of the study there could be unidentified archaeological or cultural artefacts or sites which could be impacted by the Project development. This could result in the accidental destruction of these unidentified archaeological or cultural artefacts.

This impact is limited to the construction phase / site clearance activities of the Project. As it is unlikely that any archaeological or cultural heritage artefacts will be impacted by Project activities, as outlined in Table 61, this impact is rated as negligible prior to mitigation and negligible following mitigation.

Operations that will have an Impact on the Environment

Mining areas and land clearance for project infrastructure may further result in accidental destruction, removal or covering of archaeological or cultural artefacts.

Nature of Impact

Assessment Methods

The assessment took into account the project layout and the location of identified archaeological and cultural artefacts as well as the archaeological history of the area.

Mitigation

- **Avoidance measures –** Identify archaeological and cultural artefacts prior to site clearance and construction and apply appropriate conservation and or protection measures.
- **Reduction measures** – to reduce the risk of unintentionally damaging archaeological or cultural artefacts, induction, on-going communication and chance find procedures should be established prior to construction and implemented during construction;
- **Restoration measures** – Restoration measures should be defined as applicable through the chance find procedures;
- **Compensation measures** – Compensation measures should be defined as applicable through the chance find procedures
- **Monitoring mechanisms** – Construction (ground clearance) activities should be closely monitored immediately prior to and during such activities.

8.6 Certainty of Assessment

For the Sociological Impacts evaluated the level of certainty based on professional opinion and experience within the DRC, gives an overall medium to high confidence of the prediction of impacts outlined above.

8.7 Sociological Impact Assessment Summary

Table 61: Impact Assessment Summary

ID	Aspect	Phase / Timing	Impact Summary	Impact Characterisation – Prior to Mitigation												Impact Characterisation – Post Mitigation											
				Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	Probability of Occurrence	**Overall Risk (Magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility	Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	**Probability of Occurrence**	**Overall Risk (magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility
SOC 1	Social	Construction	Physical and economic displacement of households	Neg	5	2	5	5	5	4.4	5	22	Sev	1	PR	Neg	4	2	5	3	3	3.4	5	17	Maj	1	PR
SOC 2	Social	Construction	Employment opportunities	Pos	2	2	2	3	1	2	4	8	Low	3	ER	Pos	3	3	2	3	1	2.4	5	12	Mod	3	ER
SOC 3	Social	Construction and Operations	Community Development	Pos	2	2	4	3	1	2.4	3	7.2	Low	3	ER	Pos	3	2	5	3	1	2.8	5	14	Mod	3	ER
SOC 4	Social	Construction and Operations	Economic benefits	Pos	2	4	4	3	1	2.8	4	11.2	Mod	2	ER	Pos	3	4	4	3	1	3	5	15	Mod	3	ER
SOC 5	Social	Construction and Operations	Increased demand for and pressure on land and natural resources	Neg	4	2	4	4	4	3.6	5	18	Maj	4	PR	Neg	3	2	4	4	2	3	4	12	Mod	3	PR
SOC 6	Social	Construction and Operations	Pressure on basic services and infrastructure	Neg	4	3	4	4	4	3.8	5	19	Maj	3	PR	Neg	3	2	4	4	2	3	4	12	Mod	3	PR
SOC 7	Social	Construction	In-migration of workers at construction camp	Neg	3	2	4	4	4	3.4	4	13.6	Mod	3	PR	Neg	2	2	4	2	2	2.4	3	7.2	Low	3	PR
SOC 8	Social	Construction and Operations	Impacts to community health caused by population influx	Neg	3	2	4	4	4	3.4	4	13.6	Mod	3	PR	Neg	2	2	4	4	4	3.2	3	9.6	Mod	3	PR
SOC 9	Social	Construction and Operations	Impacts to community health caused by environmental impacts to air quality, noise and water quality	Neg	3	2	4	4	4	3.4	4	13.6	Mod	3	PR	Neg	2	2	4	4	4	3.2	2	6.4	Low	3	PR
SOC 10	Social	Construction and Operations	Impacts to community safety through increased traffic and mine operations	Neg	3	2	4	4	4	3.4	3	10.2	Mod	4	PR	Neg	2	2	4	4	4	3.2	2	6.4	Low	4	PR
SOC 11	Social	Construction and Operations	Restrictions to access routes	Neg	4	2	4	3	2	3	5	15	Mod	1	PR	Neg	2	2	4	3	2	2.6	2	5.2	Low	3	PR
SOC 12	Social	Construction and Operations	Changes in livelihood strategies	Neg	4	2	4	4	3	3.4	4	13.6	Mod	2	PR	Neg	2	2	4	4	3	3	4	12	Mod	2	PR

ID	Aspect	Phase / Timing	Impact Summary	Impact Characterisation – Prior to Mitigation												Impact Characterisation – Post Mitigation											
				Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	Probability of Occurrence	**Overall Risk (Magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility	Direction	Intensity	Extent	Duration	Value of Affected Component	Risk to Human Population	**Magnitude of Consequence**	**Probability of Occurrence**	**Overall Risk (magnitude x Likelihood)**	**Overall Impact Risk Score**	Frequency	Reversibility
SOC 13	Social	Construction, Operations, Decommissioning and Closure	Changes in cultural identity	Neg	3	2	5	4	2	3.2	4	12.8	Mod	1	PR	Neg	2	2	5	4	2	3	3	9	Low	1	PR
SOC 14	Social	Construction, Operations and Decommissioning	Inflation affecting cost of living and quality of life	Neg	3	3	4	4	3	3.4	3	10.2	Mod	2	PR	Neg	2	3	4	4	3	3.2	2	6.4	Low	2	PR
SOC 15	Social	Construction, Operations and Decommissioning	Increased potential for conflict	Neg	3	2	4	3	3	3	3	9	Low	1	PR	Neg	2	2	4	3	3	2.8	2	5.6	Low	1	PR
SOC 16	Cultural	Construction	Relocation of cemeteries due to Project development	Neg	5	1	1	5	5	3.4	5	17	Maj	1	I	Neg	5	1	1	5	5	3.4	3	10	Mod	1	PR
SOC 17	Cultural Heritage	Construction	Destruction of sacred sites and /or exposure of sacred sites to non-local people due to the Project	neg	2	1	1	5	5	2.8	3	8.4	Low	1	I	Neg	2	1	1	5	5	2.8	1	2.8	Non	1	I
SOC 18	Cultural Heritage	Construction	Accidental destruction, removal or covering of archaeological or cultural artefacts /locations as a result of Project development	neg	2	1	1	1	1	1.2	3	3.6	Non	1	PR	Neg	2	1	1	1	1	1.2	1	1.2	Non	1	PR

9.0 OBLIGATION TO PRESENT A PROGRAM OF ATTENUATION AND REHABILITATION

9.1 Organisational Structure

Primary responsibility for implementation of the Environmental Management Plan for the Project (EMPP) is with the Operations Manager of Kamoa SA. The organisational structure is presented in Figure 76.

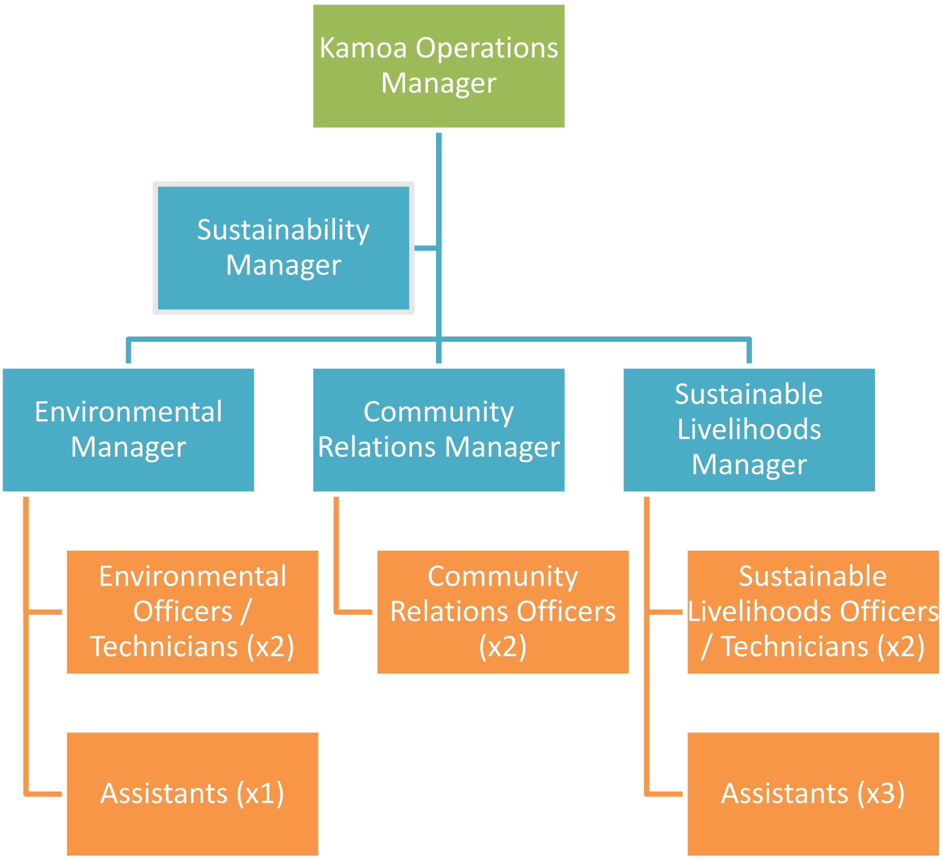


Figure 76: Kamoa SA Sustainability Department Organogram

9.2 Environmental Policy

Kamoa Copper SA recognises that all employees working on the Kamoa Copper Project are important and that every individual has the right to a safe and healthy workplace. The Safety Health and Environment (SHE) Policy objective is to execute the scope of work in such a manner that no stakeholder is injured in any way or form during exploration, construction or operation of the mine. Kamoa will also ensure that the works are executed and operated in an environmentally friendly manner with regards to the community in which the mine operates. A zero harm, zero tolerance approach will be the general target of the project.

9.2.1.1 Health and Safety Policy

The Kamoa Health and Safety Policy is aligned with DRC standards. It aims to ensure the health, safety and general wellbeing of all its employees, contractors and visitors. Kamoa is committed to the following:

- Provision and maintenance of appropriate facilities (lab and workshop) and equipment that is safe and without risk to health;
- Assurance for safety and health in relation to the use, handling, storage and transportation of hazardous substances and/or materials;
- Provision of sufficient information, instruction, training and supervision;

- Investigation of incidents causing injury, property damage, near misses or non-conformances with relevant reporting; and
- The creation and development of a culture that has health and safety as an integral part of all operations and all performance management systems.

9.2.1.2 Environment Policy

Through the Environment Policy, Kamoa commits to comply with DRC environmental standards in environmental management for its exploration and operations activities. It aims to ensure the long term sustainability and minimal degradation and impact on surrounding ecosystems in areas of operation. Kamoa will achieve this by:

- Integrating environmental management practices into exploration activities;
- Ensuring its activities comply with DRC legislative standards;
- Identifying, monitoring and assessing environmental management and compliance (performance);
- Working with government, political and administrative authorities, as well as local traditional leaders, to develop effective, efficient and equitable measures to minimise the environmental impact of the company's activities;
- Ensuring all contractors and suppliers embrace and comply with this policy;
- Ensuring that all employees understand and are given the opportunity to meet their environmental responsibilities; and
- Working closely with the local communities and communicating its policies through public consultations.

9.3 Environmental Management Plan for the Project

Table 62, Table 63 and Table 64 provides the Environmental Management Plan for the Project (EMPP).

Table 62: Physical Impact Management Plan

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV01	Topography	Construction/ Operations/ Closure	Topographical impacts resulting from the proposed WRDs near Kansoko and Kakula portals, concentrators at both mine sites and the TSF located at Kakula.	Minimise topographical impacts	Kamoa will: Design the TSF for zero discharge and undertake rehabilitation following closure; Carryout subsidence surveys to determine any surface subsidence, and consider amending the mining method to protect surface topography; In the event of subsidence carry out works as necessary to restore surface drainage and prevent ingress to mine workings; Undertake annual geotechnical monitoring of the waste rock dumps and TSF for any tailings or rock movements respectively to minimise the risk of any structural collapse which would further impact on topography; and Keep the clearance of areas required for the profile facilities such as TSF and WRDs to a minimum area to the extent practical, carryout concurrent rehabilitation and natural vegetation retained as a screen.		Subsidence monitoring (annual topographical surveys). Environmental auditing	Infrastructure developed and maintained as per deign. Subsidence monitored and mitigated as required.	Operations Manager	Construction	Closure	Included in operational costs.
ENV02	Soils, Land Use and Land Capability	Construction/ Operations/ Closure	Soil degradation and loss due to project implementation.	Minimise and control soil degradation	Kamoa will: Minimize surface footprints to the extent possible and restrict heavy machinery and heavy truck access to sensitive soil areas (Dilungu and Dambo areas); Minimize soil contamination through containment and handling of potentially polluting materials and implement Acid Rock Drainage (ARD) and Metal Leaching mitigation measures for identified materials; Implement soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation and maintaining soils fertility on topsoil's stored for future rehabilitation); Ensure that the overall thickness of the soils utilised for rehabilitation is consistent with surrounding undisturbed areas and future land use; Designing slopes to an appropriate gradient for rehabilitation; and Basing the soil fertilizing programs on the soil chemical, biological and physical status after topsoil replacement.	Soils handling and storage procedures as per Section 10.0	Environmental Auditing and annual rehabilitation monitoring	Soil measures in place and implemented	Environmental Manager	Construction	Closure	Included in operational costs.

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV03	Soils, Land Use and Land Capability	Construction/ Operations	Increased soil erosion to earth material movement	Minimise and control soil erosion	Kamoa will: Avoid development of infrastructure in erosion sensitive areas; Avoid soil erosion through the design of roads systems with appropriate drainage channels along the roads; Schedule construction works to avoid heavy rainfall periods (i.e. during the dry season) to the extent practical; Re-vegetate areas promptly; Line steep channel and slopes; Prevent off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical; Segregate or divert clean water runoff to prevent it mixing with water with a high solids content, to minimize the volume of water to be treated prior to release; Limit access road gradients to the extent practical to reduce runoff-induced erosion; Provide adequate road drainage based on road width, surface material, compaction, and maintenance. Applying appropriate designs of diversion drains around mine sites, tailings dam and waste rock dumps; Undertake annual maintenance of drainage channels especially before the onset of the rainy season; Minimise areas of exposed soils; Identify and stabilise areas that are highly susceptible to erosion; and On an annual basis, identify, prioritise and rehabilitate eroded areas with appropriate revegetation and/or engineering solutions.	Erosion control	Auditing and annual rehabilitation monitoring	Soil erosion controls in place an implemented	Environmental Manager	Construction	Closure	Included in operational costs.

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV04	Soils, Land Use and Land Capability	Construction/ Operations	Change of land use on the footprints of the proposed mine facilities.	Minimise landuse changes	Kamoa will: Minimise the project footprint and therefore disturbance to a minimal area as possible; Restrict access to sensitive soil areas (i.e. use smaller graders in sensitive areas); Avoid mixing topsoil with subsoil during storing of topsoil. Topsoil will have to be removed prior to site disturbance from the TSF, WRD, concentrator, decline areas and ancillary facilities. The removed soil will be stockpiled in a particular area and demarcated; Identify and investigate sustainable land use options within the mine footprint and adjacent communities; and Promote sustainable land use and agricultural practices in the Project Area and adjacent areas.		Landuse mapping	Soil measures implemented	Environmental Manager	Construction	Closure	Included in operational costs.
ENV05 to ENV 12	Refer to Sections 9.4 , 9.5 and 9.7											
ENV13	Radiation	Operations	Mining of radioactive material could be a health hazard to people and the general environment.	Monitor and protect any adverse radiation effects	Kamoa will: Minimize by means of applying dust suppression techniques in areas where site clearance/ construction and mining operations take place. These measures typically would be dust suppression by spraying of water in areas/roads etc. where high volume traffic e.g. trucks etc. are found; Rehabilitate/Repair of waste storage areas, e.g. at tailings facilities; by limiting Dust inhalation (re-suspension), Dust deposition, Radon gas releases and contaminated water (leaching) For example; vegetate TSF to prohibit dust releases. Ensure TSF facilities do not release contaminated water etc; Early identification of potential impacts through a continuous radiological environmental monitoring programme (inclusive of radon gas monitoring underground).		Radiological monitoring	Radiation levels within DRC norms	Environmental Manager	Operations	Closure	US$5000/annum

Table 63: Biological Impact Management Plan

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost

BIO 1	Terrestrial Ecology	Construction Operation and Decommissioning	Vegetation clearing	Minimise the effects of ground clearing and carry out on-going and concurrent rehabilitation	Land clearance will be limited to the areas demarcated by the final mine plan. Areas to be cleared will clearly marked on plans and on the ground and the restrictions clearly communicated to contractors. Land clearance will be monitored and quantified through remote sensing (aerial surveys or satellite imagery) to track and evaluate the extent of land clearance. No clearance of land will be allowed outside designated areas without authorisation from the Environmental Manager. Land clearance procedures will be implemented prior to any works, and will include the identification and salvaging of protected species. A revegetation nursery will be established prior to the commencement of construction. Trees and plants grown will be locally collected Miombo woodland seed species (linking with the work currently undertaken by Eco-Livelihoods). For every hectare lost a number trees and plant species will be replanted in and around the Project area, these trees can be grown in a nursery managed by Kamoa. Concurrent rehabilitation procedures and processes (as defined in the rehabilitation and closure plan) will utilise indigenous plant species for revegetation. Rehabilitation trials will be established linking soil types with indigenous grass and tree species, and various methods of seeding and/or planting of indigenous trees will be undertaken until the most efficient method is determined. This will then be rolled out as part of the rehabilitation strategy. An offsetting strategy will be developed based on the principles of the Business and Biodiversity Offsetting Program (BBOP).	Land clearance procedures. Rehabilitation procedures	Biannual monitoring of terrestrial systems and land clearance. Environmental audits.	Land clearance in line with mine plan. Land clearance procedures adhered to. Revegetation nursery established. 1000 trees planted for every hectare lost. Rehabilitation procedure sin place. Closed areas rehabilitated within 12 months of closure. Biodiversity offsetting strategy in place and implemented.	Env Mgr	Construction	Closure	$100 000 pa

BIO 2	Terrestrial Ecology	*Construction Operation and Decommissioning*	Contamination of soils and water sources from accidental spills and /or contamination from stockpiles, waste rock dumps and/or the TSF	Implement pollution prevention and control measures to minimise contamination.	Implement the measures outlined in the surface water study for pollution prevention and control for hazardous substances. Implement design, construction and operational measures as outlined in the geochemistry study for the prevention and control of acid rock drainage and metal leaching from Project infrastructure. Training of workers in the maintenance and handling of dangerous substances and implementation of a sound emergency spillage containment plan, which can be implemented as soon as a spill of harmful or toxic substances occurs. No herbicides or pesticides (aside from malarial control pesticides) will be allowed to be used onsite. Should vegetation encroachment need to be controlled this will be undertaken manually with organic material collected and composted.	Hazardous materials handling and storage procedures as per Materials Safety Data Sheets (MSDS). Emergency spills containment and recovery procedures. Waste rock, stockpiles and TSF operating procedures. Training procedures.	Environmental auditing and site inspections. Monitoring as per surface water and geochemical management plans.	Zero contamination of ecological habitats adjacent to mining operations	Env Mgr	Construction	Closure	Included in surface water and geochemistry management plans.
BIO 3	*Terrestrial Ecology*	*Construction operation and decommissioning*	Noise and vibration form construction and operational activities causing sensory disturbances;	Noise and vibration levels within project Environmental Design Criteria levels, DRC standards	Implement the measures outlined in the noise and vibration management plan.	As per Noise and vibration management plan	As per Noise and vibration management plan	As per Noise and vibration management plan	Env Mgr	Construction	Closure	As per Noise and vibration management plan
BIO 4	*Terrestrial Ecology*	*Construction operation and decommissioning*	Dust and air emissions from construction and operational activities particularly traffic and smelter emissions;	Air quality (dust and emissions) in line with Project environmental design criteria, DRC Standards.	As per air quality management plan. In addition monitoring of dust impacts on flora through bi-annual terrestrial monitoring.	As per Air Quality Management Plan	As per Air Quality Management Plan. Bi-annual terrestrial monitoring. Environmental Audits.	Compliance with, DRC Standards.	Env Mgr	Construction	Closure	As per Air Quality Management Plan

BIO 5	*Terrestrial Ecology*	*Construction operation and decommissioning*	Barriers created by linear infrastructure impeding local migration of fauna	Reduce injury or death of migrating animals on roads and prevention of the interruption of local migrations.	Detailed design of roads to incorporate culverts and drift fences to allow for the passage of local fauna at at least 1km intervals. Detailed design of pipelines to include regular crossing points for animals (at at least 1km intervals). Speed restrictions and limits to be implemented throughout all project roads as per the health and safety management plan.	None	Road and linear infrastructure inspections can be investigated for dead or trapped animals during environmental audits and site inspections.	Minimal death of animals or restriction of animal movements	Env Mgr	Construction	Closure	Included in operating costs
BIO 6	*Terrestrial Ecology*	*Construction operation and decommissioning*	*Traffic and influx resulting in increases in exotic / invasive species of flora and fauna, affecting local habitats*	Prevent infestation by exotic species	An invasive species will be controlled by: Identifying and monitoring invasive species through auditing and site inspection – particularly of cleared areas and soil stockpiles. Environmental offices will be trained in the identification of exotic species of plants Implementing control measures for invasive species, such as manual or thermal destruction. No pesticides or herbicides will be utilised to control invasive species. Invasive control programs will consider utilising community resources to implement the plan.	Invasive species control procedures.	Biannual monitoring of terrestrial systems. Environmental auditing and site inspection.	No extensive infestation by exotic species	Env Mgr	Construction	Closure	Included in operating costs
BIO 7	*Terrestrial Ecology*	*Construction /Operation/ Decommissioning/ Closure*	*Development of access roads resulting in increased access to previously inaccessible areas resulting in increased pressure on terrestrial habitats*	Reduce access to previously inaccessible areas	An influx management strategy to proactively manage population influx to the area will be developed. Sensitive areas will be designated on maps and communicated to employees and contractors. Infrastructure such as roads in the areas will be designed to avoid sensitive areas to the extent practicable. A community based natural resource management program will be established as part of a wider sustainable development plan for the Project linked to the Sustainable Development Plan. Employees and contractors will be forbidden from hunting, or bringing firearms or pets on to site.	Refer to Influx Management Plan and Biodiversity Action Plan.	Refer to Influx Management Plan and Biodiversity Action Plan.	Influx management plan in place and implemented. Biodiversity Action Plan includes a community based natural resource management program. No hunting by employees/ contractors and no firearms or pets on site	Security officer, mine manager	Construction	Closure	Included in operating costs

BIO 8	Aquatic Ecology	Construction /Operation	Degradation of aquatic habitat	Avoid disturbing or losing any aquatic habitat or biota / Protection of the aquatic Resource / Improve and rehabilitation of degraded areas	All watercourses and riparian zones will be clearly marked on maps and designated as sensitive areas, where all activities will be restricted and only allowed following authorisation by the environmental manager; All aspects of the surface water management plan will be implemented; All culverts will be designed to allow for natural flow; Monitoring of the aquatic habitat and biota; and Implementing the surface water management program.	Habitat characterization as per baseline studies, and surface water quality monitoring and assessment of instream biota	Biomonitoring Program,	Maintain baseflow and water quality (thought the year in perennial rivers) within guideline ranges for aquatic biota biota In situ parameters should not exceed or fluctuate from baseline measurements	Project Environmental Manager and Environmental Site Officer	Construction	Closure	*Included in ecological costs*
BIO 9	Aquatic Ecology	Construction /Operation	Reduced diversity and abundance			Habitat characterization as per baseline studies, assessment of instream biota and riparian vegetation		Maintain and where possible improve habitat No erosion of banks, no sedimentation of habitat				

BIO 10	Wetland	Pre-contraction, construction, and operation	Loss and fragmentation of riparian and watershed grasslands	Avoid/ reduce loss and fragmentation of riparian and watershed grasslands	Measures to remove and rehabilitate the temporary access roads and drilling sites should be put in place as part of an overall rehabilitation strategy for the mine. All affected sites should be identified and a cleanup and rehabilitation plan should be implemented at these sites which should include as a minimum: ■ The removal of the sludge and other waste drilling materials and oils from the sites; ■ Reinstating the local topography; and ■ Ripping of the compacted soil, and re-vegetation of the affected areas. A monitoring programme should be put in place to ensure compliance with the rehabilitation plan and adequate recovery of the affected areas. No heavy machinery should be allowed in watershed grassland, wetland or riparian systems unless specifically authorised and clear instructions pertaining to avoidance of impacts and compliance with the EMP are provided. Permanent access roads must be appropriately designed for storm water. All construction servitudes (excluding roads), including lay down, dam, TSF and stockpile areas should be fenced off and clearly demarcated. Strategies for housekeeping should be implemented and waste must be removed to appropriate and approved landfills. Recycling should be encouraged and staff and contractors must be fined for littering or incorrect handling and management of waste (i.e. after relevant training is undertaken). A detailed management plan for handling of waste should be developed.	Procedures must be developed for: ■ Site clean-up and rehabilitation ■ Offsetting net biodiversity, wetland, and riparian habitat/ functionality loss where rehabilitation is not feasible. ■ Storm water management for infrastructure (particularly roads and borrow pits). ■ Spillages and overflow	Water quality monitoring programme and risk management strategy for both surface and sub-surface water monitoring, particularly in respect of the sections of the watershed grasslands that lie outside the footprint and the drainage lines and rivers that drain to the west.	Adequate recovery/ re-vegetation of affected areas (as assessed by a suitably qualified and experienced botanist) All sites to be suitably rehabilitated in by a date that is reasonably achievable and acceptable to the authorities. Hectare equivalent offset targets for those losses associated with residual impacts.	Project Environmental Manager and Environmental Site Officer	*Prior to commencing with construction*	*Construction phase*	

Table 64: Sociological Management Plan for the Project

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 1	Social	Construction	Physical and economic displacement of households.	Livelihoods and quality of life of displaced persons improved or restored.	Kamoa will prepare and implement a RAP to ensure that Project-affected people, households, and communities are compensated fairly and equitably.		To be defined in RAP. Annual social surveys of Project Affected People.	Improvements to project affected people, education, health status, livelihood, income levels.	Sustainability Manager	Pre-Construction	Post-Closure	Estimated USD 750 000 million (calculated based on estimated USD25 000 per household and assuming 30 households to be resettled).

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 2	Social	Construction	Employment opportunities.	Maximise employment for local communities.	Kamoa will continue to: engage with stakeholders to ensure employment is fairly and evenly distributed, develop a local labour pool of qualified local workers, develop a skills transfer and human resource development strategy to ensure up-skilling of local employees throughout the project life, and develop a local contractor pool and employment strategy to maximize indirect employment. Kamoa will ensure that the closure plan for the mine incorporates objectives to establish such sustainable land uses as feasible. Kamoa will continue with its employee skills development programs so in the event of retrenchment employees have transferable skills.		Audit of ESMP once every 2 years	>20% of employment sourced from local communities.	Human Resources / Sustainability Manager	Pre-Construction	Operations	Included in existing budget.
SOC 3	Social	Construction	Community Development.	To improve peoples' quality of life and contribute to the long-term strengthening of community viability.	Kamoa will update the sustainable development plan on an annual basis using information from community consultation, social and environmental baseline data, local, regional and national development plans and agendas, and previous community development projects focusing on skills, education, health, and social infrastructure.		Monthly reports of community development activities, minutes of meetings held with Community Development Committees, and annual evaluation of commitments outlined in the Sustainable Development Plan.	Improvement in key social indicators such as health, education and quality of life within the exploitation licence area.	Sustainability Manager	Pre-Construction	Post-Closure	Included in SDP budget
SOC 4	Social	Construction	Economic benefits.	Maximise direct and indirect economic benefits.	Kamoa will continue implementing its skills development programs and support development of small businesses to maximise direct and indirect employment opportunities, increasing the potential for induced economic benefits of the project.		Audit of ESMP once every 2 years	Skills development and business support undertaken.	Sustainability Manager	Pre-Construction	Closure	Included in existing budget

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 5	Social	Construction and Operations	Increased demand for and pressure on land and natural resources.	Minimise population influx and reduce pressure on land.	Kamoa will establish designated access routes and control access to the mines. Kansoko and Kakula areas will be fenced to restrict access. Employees will be accommodated within the fenced areas or in Kolwezi. No employment or procurement will be undertaken at the gate of the mines but at designated areas (e.g. in Kolwezi). Alternative livelihood strategies and skills development will continue to be evaluated through the SDP to provide alternate income sources and establish more sustainable form of livelihood.		Audit of ESMP once every 2 years.	Access controls in place. Employment and procurement in designated locations.	Sustainability Manager	Pre-Construction	Closure	Included in project development budget
SOC 6	Social	Construction and Operations	Pressure on basic services and infrastructure.	Minimise population influx and maintain or improve access to services.	Kamoa will continue to minimise population influx through implementation access controls, employment procedures and accommodation strategies (see above). Kamoa will continue to include the development of additional educational, health, water, sanitation and waste disposal facilities in local communities in the SDP.		Audit of ESMP once every 2 years.	Continual improvement to social infrastructure through the SDP.	Sustainability Manager	Pre-Construction	Closure	Included in project development budget
SOC 7	Social	Construction	In-migration of workers at construction camp.	Avoid development of informal service centres near camp.	Kamoa will: design employee camps (ensuring sufficient recreational and goods services on camp to avoid the need for informal centres outside the fence to develop), fence off the mine areas and control access to limit service centre development, introduce employee health awareness campaigns and health facilities to limit impacts to community health.		Audit of ESMP once every 2 years.	No informal service centre developed.	Sustainability Manager.	Pre-Construction	Closure	Included in project development budget
SOC 8	Social	Construction and Operations	Impacts to community health caused by population influx.	Reduce population influx and maintain or improve community health.	Kamoa will implement the influx minimisation measures listed above. Kamoa will work with local partners to try to improve the availability of and quality of health care facilities to the rural population, taking into consideration access issues and will work to improve community knowledge regarding the spread and management of diseases.		Audit of ESMP once every 2 years.	Continual improvement of health care facilities within the licence area.	Sustainability Manager.	Pre-Construction	Closure	Included in project development budget

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 9	Social	Construction and Operations	Impacts to community health caused by environmental impacts to air quality, noise and water quality.	Reduce environmental impacts and maintain or improve community health.	Kamoa will apply relevant physical and biological environment mitigation measures. Kamoa will work with local partners to try to improve the availability of and quality of health care facilities to the rural population Kamoa will provide actions for potable water and sanitation as necessary through the SDP.		Audit of ESMP once every 2 years.	Continual improvement of health care facilities within the licence area.	Sustainability Manager.	Construction	Closure	Included in SDP budget
SOC 10	Social	Construction	Impacts to community safety through increased traffic and mine operations.	Avoid health and safety accidents.	Kamoa will continue developing and implementing the SDP. Kamoa will continue applying and developing its health and safety systems in particular providing guidance, training and rules for all employees involved in driving, machinery use and equipment maintenance.		Audit of ESMP once every 2 years	Zero harm of communities and employees	EHS Mgr / H&S	Construction	Closure	Included in project operating budget
SOC 11	Social	Construction	Restrictions to access routes.	Avoid loss of access to key services for communities.	Kamoa will provide alternate access routes as identified during the RAP if necessary.		Audit of ESMP once every 2 years.	Alternative access provided if required project affected people.	Sustainability Manager.	Construction	Closure	To be confirmed through RAP.
SOC 12	Social	Construction	Changes in livelihood strategies.	Avoid decline in quality of life due to changes in livelihood strategies.	Kamoa will continue to implement its employment policy which looks to employ local communities based on existing census information verified by local communities. Further Kamoa will continue the implementation of the SDP to support alternative livelihood strategies and develop agricultural practices.		Audit of ESMP once every 2 years.	Improvement in key social indicators such as health, education and quality of life within the exploitation licence area.	Sustainability Manager.	Construction	Closure	Included in project operating budget

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 13	Social	Construction	Changes in cultural identity.	Avoid uncertainty amongst communities and loss of identity.	Kamoa will continue to engage with local communities so they are aware of all project changes. Kamoa will investigate the possibility of supporting local communities to develop a cultural centre to promote cultural heritage, support traditions and provide a forum for future cultural interactions through the SDP. A grievance mechanism will be put in place to resolve grievances raised by the local community. A short summary of local culture and history will be included in the cultural heritage induction.		Grievance tracking. Monthly reports of community development activities, minutes of meetings held with Community, and annual evaluation of commitments outlined in the Sustainable Development Plan.	Improvement in key social indicators such as health, education and quality of life within the exploitation licence area.	Sustainability Manager.	Construction	Closure	Included in existing CSR budget
SOC 14	Social	Construction	Inflation affecting cost of living and quality of live.	Avoid decline in quality of life due to inflation.	Kamoa will continue to support the development of small businesses to increase supply of goods and services. Should monitoring activities discussed below reveal increasing hardships for vulnerable households as a result of inflation, Kamoa will investigate measures to provide assistance through measures identified in the SDP.		Annual monitoring of market food prices. Socio-economic survey once every 2 years. Audit of ESMP once every 2 years	Improvement in key social indicators such as health, education and quality of life within the exploitation licence area.	Sustainability Manager.	Construction.	Closure.	Included in SDP budget
SOC 15	Social	Construction	Increased potential for conflict.	Avoid community conflicts.	Kamoa will continue to engage with local communities so they are aware of all project changes. Kamoa will continue to involve the chiefs to spread consultation messages and reduce the potential for ethnic conflicts relating to perceptions of unequal involvement in the project. A Code of Conduct has been developed by Kamoa and will continue to be utilised as part of any employment contract.		Audit of ESMP once every 2 years	Community engagement undertaken	Sustainability Manager.	Construction	Closure	Included in existing project operations budget

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
SOC 16	Archaeology / Cultural	Construction	Relocation of cemeteries due to Project development	Protection and conservation of Project affected cemeteries.	**Pre-Construction** All cemeteries within communities that are Project Affected (as defined in the Resettlement Action Plan (RAP)) to be identified and mapped. Cemeteries identified will be marked and fenced off as appropriate following consultation with affected communities. Location of cemeteries to be indicated on the no-go areas map developed for the Project.		Pre-construction audit	All cemeteries identified and indicated on a map that is available to all employees and contractors.	Sustainability Manager	Pre-Construction	Closure	To be included in RAP costs
					Resettlement Action Planning (RAP) Specific action plans for each project affected cemetery will be developed within the RAP. Should the relocation of a cemetery be required, or if requested by the Project affected community through the RAP process, specific legal and local custom will be clearly defined documented and agreed with local authorities and the local community prior to carrying out any cemetery relocation. Extensive consultation will be undertaken with affected communities. The Grievance mechanism for the RAP will be extended to include aspects relating to cemeteries.	Cemetery relocation procedure (to be defined by the RAP)	Specific monitoring mechanism for cemetery relocation to be defined in the RAP.	RAP procedures developed and implemented for cemeteries. Any cemetery relocation is undertaken in line with the specific legal and community requirements to the satisfaction of the Project Affected Local Community. Grievance mechanism in place.	Sustainability Manager	Pre-Construction	Construction	To be included in RAP costs
					Detailed Design Phase During detailed design the engineering team will take into consideration the location of cemeteries in the final siting of any project infrastructure and take on board the recommendations of the RAP. Priority will be given to avoiding cemeteries. Costs for relocation of cemeteries will be included in CAPEX and OPEX.		Pre-construction audit	RAP recommendations taken into consideration in detailed design.	Sustainability Manager	Pre-Construction	Construction	Included in CAPEX and OPEX

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
					Construction and Operational Phase All employees, contractors, and visitors will be inducted using appropriate induction materials. On-going communication through posters and toolbox talks. Induction will be tracked and recorded and proof of induction will be a requirement prior to any work being undertaken.		Monthly SMP auditing. Induction tracking	All employees, visitors and contractors inducted.	Sustainability Manager	Construction	Closure	Included in overall budget (costs minimal)
SOC 16	Archaeology / Cultural	Construction	Destruction of sacred sites and /or exposure of sacred sites to non-local people due to the Project	To protect and conserve cultural heritage in the Project Area.	**Pre-Construction** All sacred sites (holy tree, rivers, locations, etc) within communities that are Project Affected (as defined in the Resettlement Action Plan (RAP)) to be identified and mapped. Sacred identified will be marked and fenced off as appropriate following consultation with affected communities. Location of sacred sites to be indicated on the no-go areas map developed for the Project. The Map developed will be marked confidential and will not be for public distribution.		Pre-construction audit	All sacred sites identified and indicated on a map that is available to all employees and contractors.	Sustainability Manager	Pre-Construction	Closure	To be included in RAP costs
					Resettlement Action Planning (RAP) Previously unidentified Sacred sites as applicable will be included in the RAP process.	Cemetery relocation procedure (to be defined by the RAP)	Specific monitoring mechanism for cemetery relocation to be defined in the RAP.	RAP procedures developed and implemented for sacred sites if necessary. Grievance mechanism in place.	Sustainability Manager	Pre-Construction	Construction	To be included in RAP costs
					Detailed Design Phase During detailed design the engineering team will take into consideration the location of sacred sites in the final siting of any project infrastructure and take on board the recommendations of the RAP. Priority will be given to avoiding sacred sites.		Pre-construction audit	RAP recommendations taken into consideration in detailed design.	Sustainability Manager	Pre-Construction	Construction	Included in CAPEX and OPEX

ID No	Aspect	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
					Construction and Operational Phase All employees, contractors, and visitors will be inducted using appropriate induction materials. On-going communication through posters and toolbox talks will be undertaken. Induction will be tracked and recorded and proof of induction will be a requirement prior to any work being undertaken.		Monthly SMP auditing. Induction tracking	All employees, visitors and contractors inducted.	Sustainability Manager	Construction	Closure	Included in SHEC overall budget (costs minimal)
SOC 17	Archaeology / Cultural	Construction	Accidental destruction, removal or covering of archaeological or cultural artefacts /locations as a result of Project development	To preserve and protect the cultural heritage	**Pre-construction / construction** A Phase 2 archaeological survey will be commissioned immediately prior to site clearance within areas demarcated for site clearance/disturbance. Any finding will be subject to the chance find procedures. Support of a research Project and the use of students from of a local University will be considered as a potential option for the survey.	Chance Find Procedure	Pre-construction audit. Construction supervision.	Pre-construction archaeological walkovers undertaken.	Sustainability Manager	Pre-Construction	Construction	Team of archaeological researchers for 1 month (assumed group of 4) – US$ 20 000
					Construction and Operational Phase All employees, contractors, and visitors will be inducted using appropriate induction materials. On-going communication through posters and toolbox talks will be undertaken. Induction will be tracked and recorded and proof of induction will be a requirement prior to any work being undertaken. Chance find procedures will be established and distributed to all employees and contractors as appropriate.	Chance Find Procedure	Monthly SMP auditing. Induction tracking	All employees, visitors and contractors inducted. Chance find procedure in place and chance finds recorded.	Sustainability Manager	Construction	Closure	Included in overall budget (costs minimal)

9.4 CHAPTER II: ATTENUATION MEASURES RELATING TO NOISE AND VIBRATION

To monitor the noise and vibration impacts of the Project and maintain compliance with the adopted evaluation criteria the following noise and vibration mitigation measures have been developed. The plan details the type and frequency of monitoring required, the actions to be taken should exceedences of the criteria be detected and with whom the responsibility lies for its implementation.

The DRC mining code provides noise, blast vibration and air overpressure limits for sensitive receptors. These are fixed limits and should not be exceeded at any receptor as a result of Project activities. Specifically in the DRC a noise and vibration management plan must:

- Indicate the attenuation measures relating to noise;
- Indicate measures to ensure that continuous noise are within sound level guidelines of the DRC mining for *the specific land categoreis namely:*

(a) Land in which there are several residential dwellings forming a community or village, a school or a hospital or any other educational, health or convalescence service establishment;

(b) Land in which permanent commercial hunting or fishing activities or recreational activities take place. However, the noise level provided for night-time applies only within the limits of ownership of residential dwellings. Elsewhere, the maximum noise level provided for day-time also applies at night-time; or

I Land in which mainly industrial or agricultural activities take place. However, where an existing residential dwelling is located in this land type, the thresholds are 50 dB(A) at night-time and 55 dB(A) in day-time.

- Indicate measures for mitigating vibrations and noise during blasting.

The objectives of this Noise and Vibration Management Plan are to:

- Comply with all relevant DRC legal requirements;
- Manage and minimise the impact of noise and vibration from the proposed operations on the local villages and environment; and
- Maintain an effective monitoring program and response mechanism to deal with noise and/or vibration threshold exceedences and complaints.

The noise and vibration management program is presented in tabular format as Table 65.

Table 65: Noise and Vibration Management Program

ID	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV07	Design Phase	Project-related noise levels at sensitive receptors in excess of the evaluation criteria: 45 dB $L_{Aeq,1hr}$ during the daytime period (07:00 – 19:00) and 40 dB $L_{Aeq,1hr}$ during the night-time period (19:00 – 07:00) OR 3 dB(A) above measured baseline noise levels.	Apply noise and vibration reduction design criteria elements to the Detailed Feasibility Study.	Ventilation raises will be located a maximum distance from sensitive receptors as far as practicable. Ventilation exhausts will be designed with noise attenuation and to direct exhaust fumes upwards and not towards receptors. Planning for the restriction on construction hours to daylight hours (6:00am to 18:00pm). Procurement procedures of items of equipment, both fixed and mobile, should be include preferences for lower noise models, where possible.	None	Detailed Feasibility Review.	Ventilation fans located as far away from receptors as possible. Design of ventilation exhausts to point upwards. Noise attenuation incorporated into building design. Construction activities restricted to day time hours. Procurement takes into account lower sound output levels in selection.	Project Engineer.	Pre-construction	Operations	Included in Project capital cost
	Construction and Operations	Project-related noise levels at sensitive receptors in excess of the evaluation criteria: 45 dB $L_{Aeq,1hr}$ during the daytime period (06:00 – 18:00) and 40 dB $L_{Aeq,1hr}$ during the night-time period (18:00 – 06:00) OR 3 dB(A) above measured baseline noise levels.	Maintain compliance with the evaluation criteria throughout every stage of the project and minimise unnecessary noise at all nearby sensitive receptors.	Project employees will be trained to operate a sound level meter and how to undertake reliable environmental noise measurements. A communications plan will be enacted to communicate the results of the monitoring to nearby residents and to record and investigate any noise complaints. Site clearance activities will be restricted to daytime periods (06:00am – 18:00pm)	Noise monitoring procedure to be developed	Monitoring will be coordinated with daily activities, such that noise levels at receptors in closest proximity to noisy works are captured. Additional receptors may be added to the program depending on work patterns. Monitoring will be completed for a minimum 24 hours' continuous measurement to be completed per receptor, per month. Measured levels will be recorded in a log and checked for compliance with the evaluation criteria.	Measured noise levels will be recorded in a daily log which will note the dominant noise sources. Project-related noise levels at sensitive receptors will not exceed the evaluation criteria. Noise complaints will be investigated within 24 hours.	Environmental Manager	Construction	Closure	Noise monitoring equipment already purchased. Maintenance costs at US$ 1000/annum
ENV 08	Constructi on and	Project-related blast vibration levels at sensitive receptors in excess of the evaluation	Undertake blasting to minimise vibration levels	Kamoa will where possible avoid or minimize the use of explosives;	Blasting procedure to be developed	Vibration monitoring	Project-related vibration levels at sensitive receptors will not exceed DRC standards	Operations Manager	Construction	Closure	Included in operational costs

ID	Phase / Timing	Impact Summary	Objective	Detailed Management measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
		criteria: ground-borne vibration 2.0 mm/s PPV, air overpressure of 120 dBL.		Adequately design the foundations of primary crushers and other significant sources of vibration to reduce the impacts of vibration; Use specific blasting plans, correct charging procedures and blasting ratios, delayed/micro delayed or electronic detonators, and specific in-situ blasting tests (the use of down hole initiation with short-delay detonators improves fragmentation and reduces ground vibrations); Undertake blast design, including a blasting-surfaces survey, to avoid over-confined charges, and drill-hole surveys to check for deviation and consequent blasting recalculations; and Monitor ground vibration at sensitive receptors and evaluating any impact on structures should they occur.							
	Construction and Operations	Project-related blast vibration levels at sensitive receptors in excess of the evaluation criteria: ground-borne vibration 2.0 mm/s PPV, air overpressure of 120 dBL.	Maintain compliance with the evaluation criteria throughout every stage of the project and minimise unnecessary vibration at all nearby sensitive receptors.	Project employees will be trained to operate a vibration meter capable of recording air overpressure and ground-borne vibration A structural survey of buildings in receptor locations will be undertaken to assess their existing integrity before blasting commences. A structural survey will be completed annually thereafter to check for vibration-related damage. A communications plan will be enacted to communicate the programme of blasting to nearby residents and to record and investigate any complaints.	Ground-borne vibration and air overpressure monitoring will be undertaken in compliance with the procedure set out in a suitable Standard.	Monitoring will be coordinated with daily activities, such that vibration levels at receptors in closest proximity to blasts are captured. Additional receptors may be added to the program depending on the blast schedule and during the operations phase as the lateral extent of the underground workings increases. Measured levels will be recorded in a log and checked for compliance with the evaluation criteria.	Project-related vibration levels at sensitive receptors will not exceed DRC standards. Complaints and damage reports will be investigated within 24 hours.	Environmental Manager	Construction	Closure	US$ 20 000 for vibration monitoring equipment

9.4.1 Monitoring Program

The requirements of the monitoring program are anticipated to change throughout the lifespan of the Project. Each phase of the Project will affect receptors to a varying degree, depending on the work areas, plant in use and hours of work.

9.4.1.1 Noise

During construction, when the intensity of works is anticipated to be variable, monthly noise surveys will be undertaken at the receptors closest to the active work areas (for Kansoko this will be at the following communities Israel, Mundjendje, Kaponda and Londorino and for Kakula the villages of Muvunda and Samukoko) . Each receptor will be monitored for a period not less than 24 hours and the results compared with the evaluation criteria.

During the operations phases, when noise levels are anticipated to be less variable, the frequency of monitoring will be reduced to annual surveys, with spot-checks of 1 hour's duration during the daytime and night-time at receptors conducted monthly. Additional 24-hour surveys will be conducted should noise complaints be received.

9.4.1.2 Vibration

Vibration surveys will be completed in accordance with the method set out in an appropriate Standard, such as BS 5228. The frequency of the surveys will be determined by the program of blasting, however, at least the two closest receptors will be monitored for every blast for the first five blasts in each blast location.

9.5 CHAPTER III: ATTENUATION MEASURES FOR ATMOSPHERIC EMISSIONS

This section presents the Air Quality Management Plan (AQMP) for the Kamoa Copper Project. The plan includes a list of all activities or operations producing harmful effects due to air emissions, it describes the schedule and timetables for the relevant activities and shows what measures will be taken to inform the relevant receptors of the activities in advance.

In terms of the DRC mining code (Decree No 038/2003 of 26 March 2003), the following mitigation measures are applicable:

CHAPTER III: ATTENUATION MEASURES FOR ATMOSPHERIC EMISSIONS

Content of the attenuation measures for atmospheric emissions

The measures for attenuating atmospheric emissions are presented in a maximum of three pages specifying:

- For each type of contaminant, the amount emitted (t.m./year), the emission rate (m^3/h), the temperature of the gas (°C) and the concentration of the contaminant (mg/Nm^3);
- The purification systems or measures taken to forestall, eliminate or reduce the discharge of contaminants and indicate the (%) percentage of efficiency; and
- Where dry dust collectors are used, the methods and places of storage, dumping or elimination of such dust.

The applicant must comply with the following pollution thresholds within his perimeter (Table 66) and outside his perimeter (Table 67).

Tolerated air pollution thresholds

The thresholds of air pollution within and outside the perimeter are allocated according to the type of contaminant as described in the following tables:

Table 66: Air pollution thresholds within the perimeter

TYPE OF CONTAMINANT	POLLUTION THRESHOLDS
Arsenic	0.5 mg/m^3
Carbon monoxide	29 mg/m^3
Copper	1 mg/m^3
Free silica	5.0 mg/m^3
Hydrogen cyanide	11 mg/m^3
Hydrogen sulphide	14 mg/m^3
Lead : emissions and smoke	0.15 mg/m^3
Nitrogen dioxide	6 mg/m^3
Solid particles	10 mg/m^3
Sulphur dioxide	5 mg/m^3

Table 67: Pollution levels outside the perimeter

TYPE OF CONTAMINANTS	POLLUTION THRESHOLDS
Particles of matter (< 10µm) : Annual arithmetic mean Maximum mean over 24 hours	100 g/m^3 500 g/m^3
Nitrogen oxide as NO2 : Annual arithmetic mean Maximum mean over 24 hours	100 g/m^3 200 g/m^3
Sulphur dioxide : Annual arithmetic mean Maximum mean over 24 hours	100 g/m^3 500 g/m^3

Installation of air pollution control devices

The applicant for a mine or permanent quarry exploitation right is required to install air pollution control devices in processing and transformation plants.

Pollution tests

During full mine or quarry exploitation work and ore processing work, the applicant must carry out tests inside and outside his perimeter in January, March, July and October, analyzing the levels of the contaminants listed in the above tables. He must record the testing methods used, the results of those tests and any corrective measures to be taken in a register intended for this purpose.

The applicant for a mine or permanent quarry exploitation right is required to carry out air pollution tests outside the perimeter 5m away from the perimeter boundary at the northern, southern, eastern and western points of the perimeter.

The objectives and targets of the Air Quality Management plan are to:

- Ensure all relevant legal requirements and Company Policies and Standards, are met;
- Manage and minimise the impact of air emissions/pollutants from the proposed operations of the local villages and environment;
- Maintain an effective monitoring program and response mechanism to deal with air emission threshold Exceedance and complaints;

- Achieve and sustain acceptable air quality levels throughout the project area;
- Minimise the negative impact of air pollution on people's health and well-being and on the environment; and
- To promote cleaner production processes and continuously improve practices relating to air pollution prevention and minimisation.

The Management program is presented in a tabular format below (Table 65).

Table 68: Air Quality Management Program

ID	Phase / Timing	Impact Summary	Objective	Detailed Management measures/ Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV05	Construction/ Operations	Increased greenhouse gas due to emissions from project vehicles and other mine machinery using fossil fuels	Monitor and reduce Greenhouse Gas emissions	Kamoa will undertake annual greenhouse gas monitoring and continually investigate the use of low GHG alternatives. Kamoa will further implement a greenhouse gas program which will aim to enhance energy efficiency and invest in clean technologies	Annual GHG monitoring	Monitoring and ongoing reduction of Greenhouse gases	Environmental Manager	Construction	Closure	None
ENV06	Construction and operations	Increased dust in the local area due to vehicles, construction works, dust from exposed areas (stockpiles, borrow pits, haul roads etc.), conveyors, transfer, drilling, blasting and loading areas	Avoid and/or reduce dust	Kamoa will undertake: ■ Wet suppression during materials handling activities; ■ Wet suppression of roads; ■ Wind speed reduction through sheltering for open exposed areas prone to wind erosion i.e. ROM stockpiles etc. (where possible); ■ Keep stockpile heights as low as practicable to reduce their exposure to wind erosion and thus dust generation; ■ Progressive rehabilitation and re-vegetation of closed areas; ■ Reduction in unnecessary traffic volumes; ■ Use of wet suppression during drilling: and ■ Implement blasting measures to minimise dust.	Ambient dust/particulate matter monitoring	Compliance with DRC regulations	Environmental Manager	Construction	Closure	US% 50000 for air quality monitoring equipment
	Construction and operations	Increased emissions from project operations (diesel generation and transportation)	Reduce vehicle and equipment emissions	Kamoa will: ■ Maintain and service all mining vehicles and other equipment regularly to ensure that tailpipe particulate and trace gas emissions are kept to a minimum; ■ Where possible, use low sulphur fuels to reduce SO_2 emissions; and ■ Investigate alternative back up generation with lower emissions.	Ambient air quality monitoring	Compliance with DRC regulations	Construction Manager / Environmental Manager	Pre-construction and Construction	Closure	

9.6 Monitoring Program

It is envisaged that the Kamoa air quality monitoring network will change over time based on the progressive development of the mining operation. Similarly the parameters to be monitored, the number of monitoring sites and the physical monitoring locations are anticipated to change over time. The envisaged ambient air quality networks below are thus conceptual and are subject to change in alignment with the mine plan.

9.6.1 Envisaged monitoring network

Pre-construction and during construction the air quality monitoring network is envisaged to comprise of the following:

- Ten ASTMD1739 (2010) compliant dust fallout samplers as currently installed on site;
- A professional meteorological station (1-2% accuracy) with a full suite of meteorological parameters;
- Two fine particulate monitors including one PM_{10} and one $PM_{2.5}$ monitor; and
- Trace gas pollutant monitoring (SO_2, NO_2 H_2S and BTEX) at 10 monitoring sites. Co-located with the dust fallout monitoring equipment.

The anticipated monitoring frequencies are as follows:

- Dust fallout – Continuous
- Meteorology – Continuous
- PM_{10} and $PM_{2.5}$ – Continuous
- Trace gas pollutant monitoring (SO_2, NO_2 and H_2S) – Continuous for 1 year then via suitable frequency to be decided thereafter; and
- Trace gas pollutant monitoring (BTEX) – Three month campaign then via suitable frequency to be decided thereafter.

9.7 CHAPTER IV: MEASURES TO ATTENUATE WATER POLLUTION AND DEGRADATION RISKS

9.7.1 MEASURES TO PROTECT WATER

9.7.2 Description of measures to attenuate water pollution and degradation risks

The main objectives of the water management plan (WMP) are to:

- Keep clean water away from the site through the use of sufficiently sized channels;
- Keep dirty water contained so that it cannot discharge to the environment more than once in 100 years;
- Limit the effect that the mine has on the surrounding environment by limiting discharge to the surface water environment by only discharging water of a suitable quality. And.
- Ensuring that all clean and dirty water is kept separate on site and that all dirty water is contained and treated to DRC effluent quality standards before being allowed to be discharged to the environment.

Water management measures are presented in Table 69.

Table 69: Surface Water Management Plan

ID	Aspect	Phase	Impact	Objective	Detailed Mitigation measures	Procedures	Monitoring Mechanism	Target / Performance indicator	Responsibility	Start	End	Cost
ENV09	Water quality impacts due to runoff	Construction	¡ Spillage of fuels, lubricants and other chemicals.; ¡ Construction equipment, vehicles and temporary workshop areas will be a likely source of pollution as a non-point source	Minimise surface water contamination	Kamoa will: ■ Install and maintain efficient oil and grease traps or sumps at refuelling facilities, workshops, fuel storage depots, and containment areas, and making spill kits available with emergency response plans; ■ Ensure that there is separation of clean and dirty water, minimizing run-off, avoiding erosion of exposed ground surfaces, avoiding sedimentation of drainage systems and minimizing exposure of polluted areas to stormwater; ■ Design, construct, maintain and monitor mine waste facilities in line with DRC standards to prevent impacts of poor quality seepage; ■ Attenuate surface runoff from high precipitation events by using on-site storage and water management infrastructure (e.g. storage ponds, sumps, low gradient ditches, clean water diversions); ■ Design, construct and maintain temporary drainage installations for recurrence periods of at least a 25 – year/24-hour event, with permanent drainage installations designed for a 100 – year/24-hour recurrence period; ■ Design, construct and maintain containment facilities for hazardous materials as per their corresponding Materials Safety Data Sheets (MSDS); and ■ Install barricades to limit access to disused access roads and decommission and re-vegetating once used.	Surface water monitoring	Surface Water Quality Monitoring	Compliance with DRC water quality guidelines	Environmental Manager	Construction	Closure	60 000/annum for water quality monitoring
ENV09	Contamination as a result of inadequate sanitation facilities on site	Construction	Contamination of receiving water bodies as the result of inadequate sanitation facilities being available on site	Minimise surface water contamination	Kamoa will ensure that sewage is managed via chemical toilets, portable toilets during construction activities until permanent structures are managing and treating sewage are in place.	Surface water monitoring	Surface Water Quality Monitoring	Compliance with DRC water quality guidelines	Environmental Manager	Construction	Operations	Included in contractor budgets.

	Water quality impact due to dam breach from TSF 3	Operations	Impact resulting from tailings spilling into a receiving water body as the result of tailings dam breach.	Minimise surface water contamination	The tailings dam will be designed, commissioned and operated by professionally registered individuals. Operational guidelines will be developed and followed. Annual safety and stability audits will be carried out by an independent professionally registered individual. Emergency measures will be trialled and put in place as per Section 12.2.1.	Operational Guidelines Surveys	Dam stability	Compliance with DRC water quality guidelines	Operations manager	Construction	Closure	Included in operational costs
ENV10	Decreased catchment area	Construction	Disruption and reduction in catchment area due to construction of the TSF	Minimise impact on flow in receiving water body	Kamoa will ensure clean and dirty water separation and allow clean water to be diverted away from mining activities and into the natural environment	Surface water monitoring	Surface water flow monitoring	Ensure minimal reduction in surface flow resulting from reduction in catchment	Environmental Manager	Construction	Closure	Included in construction costs

9.7.3 Water management system

A water balance and stormwater management system is currently being developed for the Kamoa Copper Project. The water balance is being developed using the available current information on the underground water management, tailings storage facility (TSF) design and the plant water balances. The current water management system is described in Section 3.8.

9.7.4 Destination of waste water and other contaminants

Kamoa will not dilute waste water and will ensure that only compliant effluent water will be discharged to receiving waters and no natural water body will be used to treat waste water.*”*

9.7.5 Separation of waste or contaminated water

The location of the plant, stockpile and decline area at Kansoko is shown in Figure 77. A similar design will be developed for Kakula. The runoff from this area will be polluted and will need to be managed within the mine’s dirty water system. Berms are required around the perimeter of the area to prevent runoff from the upslope areas entering the site. The runoff from the site is collected in berms/channels located on the northern perimeter of the area. The runoff collected by these berms is directed to a stormwater control dam located to the north of the site. The capacity of the stormwater control dam will be sized to store the runoff volume from the 100 year 24 hour storm event.

The 1:100 year 24 hour storm depth of 139 mm, calculated using the daily rainfall data measured at the Solwezi (Zambia) rain gauge, was used to calculate the runoff volume that would report to the stormwater control dam. The runoff from the catchment for the 1 in 100 year event will not be 100%. There will be losses both from depression storage and infiltration. Based on a catchment area of 66 ha, a flood volume of approximately 58,000 m^3 was estimated for the 100 year 24 hour event. This capacity is therefore recommended for the stormwater control dam.

The area of the stormwater dams at each mine will be aproximately1.5 ha, with a 4 m depth. The dam is assumed to be a cut and fill dam with the wall material sourced from the dam basin. Geotechnical studies will be required to confirm the suitability of the materials for dam construction. The dams will likely be lined.

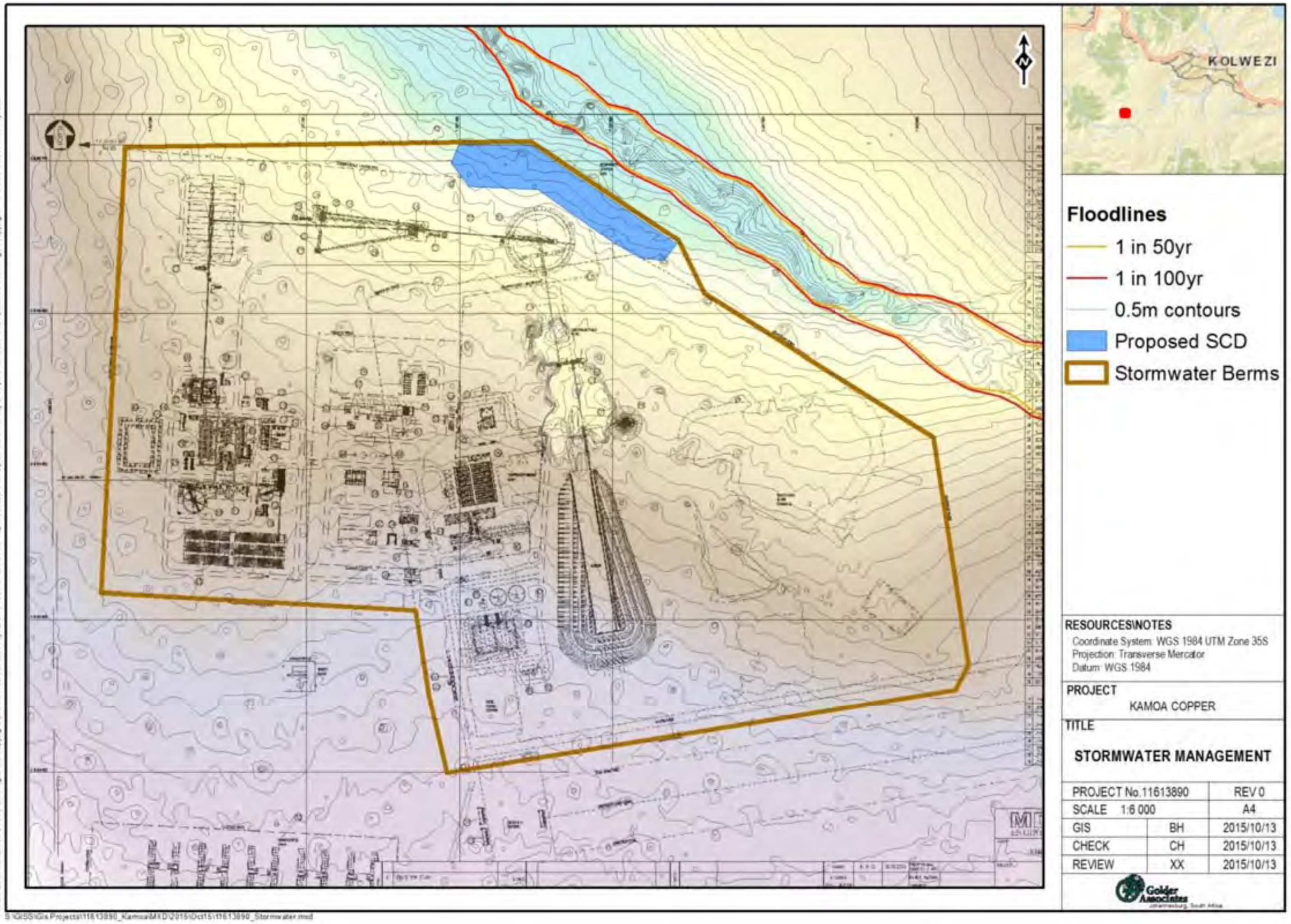


Figure 77: Polluted runoff area delineation and recommended placement of stormwater dam and berms (Kansoko Mine)

9.7.6 Maximum reduction in the use of fresh water

Kamoa are investigating opportunities to reduce fresh water use within the plant through recirculation and process amendments. The rate of recirculation will be monitored and an annual indication of the recirculation rate provided in the annual report submitted to DPEM using the following formula:

$$Tr = \frac{V1\,(1 - V3/V4) + V1^{f}}{V1 + V1^{f} + V2} \times 100$$

Tr = Rate of recirculation of mine waste water in the plant (%)

V1 = Volume of diluted mine waste water pumped to the plant (m^3/year)

$V1^{f}$ = Volume of undiluted mine waste water pumped to the plant (m^3/year)

V2 = Volume of fresh water used in the plant (m^3//year)

V3 = Volume of rainwater/runoff water at the diluted mine waste water supply source pumped to the plant (m^3//year)

V4 = Theoretical volume of water available at the diluted mine waste water supply source pumped to the plant (m^3/year).V4 is equal to the sum of the volume of rainwater/runoff water at the supply source and the volume of mine waste water discarded.

9.7.7 Protection of underground water

The attenuation measures for the protection of groundwater to be employed by Kamoa are presented in Table 70.

The key objectives are to comply with the DRC mining legislation (Mining Code, Law nr 007/2002 of 11 July 2002 and the Mining Regulations, Decree nr 038/2003 of 26 March 2003) and specifically to:

- Establish a comprehensive monitoring network to cover all potentially impacted hydrogeological units.
- Update the hydrogeological model to include the Kakula mine area based on monitoring and aquifer testing; and
- Implement measures to ensure protection of groundwater quality and availability to other groundwater users.

Table 70: Groundwater Management program

ID	Aspect	Phase	Impact	Objective	Detailed Mitigation measures	Procedures	Monitoring Mechanism	Target/ Performance indicator	Responsibility	Start	End	Cost
ENV 11	Hydrogeology	Operations	Impact on groundwater quality associated with mine facilities	Minimise groundwater contamination	Kamoa will implement the contamination mitigation as for surface water impacts (particularly with regards to the TSF and WRDs); minimise water use as per surface water impact mitigation measures; and implement ARD and ML preventive measures as indicated in the mine waste management chapter.	Groundwater Monitoring	Groundwater Monitoring	Compliance with DRC water quality guidelines	Environmental Manager	Construction	Closure	Included in operational costs
ENV 11	Hydrogeology	Operations	Impact on groundwater quality associated with mine facilities	Minimise groundwater contamination	Monitor groundwater in the area of the Process facilities Included in operational costs (Near site).	Groundwater Monitoring	Groundwater Monitoring	Compliance with DRC water quality guidelines	Environmental Manager	Construction	Closure	Included in operational costs
ENV 11	Hydrogeology	Operations	Impact on groundwater quality associated with mine facilities	Minimise groundwater contamination	Monitor groundwater upstream and downstream of the TSF and WRD	Groundwater Monitoring	Groundwater Monitoring	Compliance with DRC water quality guidelines	Environmental Manager	Construction	Closure	
ENV 12	Hydrogeology	Operations	Dewatering of the underground mines at Kakula and Kansoko	Monitor groundwater levels	Kamoa will expand the monitoring network and undertake monitoring groundwater quality and levels for potential affects of dewatering and/or contamination on local boreholes and develop contingency measures to re-supply affected local communities with water as may be necessary.	Groundwater monitoring	Groundwater quality and level monitoring	Compliance DRC water quality guidelines	Operations Manager	Construction	Closure	Included in operational costs
ENV 12	Hydrogeology	Operations	Reduction in groundwater contribution to base flow	Monitoring of surface water flow	Kamoa will monitor the flow of project rivers to ascertain any impact from dewatering on base flow of rivers. Should impacts be identified further mitigation will be investigated.	Surface flow monitoring	Surface flow monitoring	Minimal changes to surface water base flow due to dewatering	Environmental Manager			Included in operational costs

9.7.8 Management of mine waste

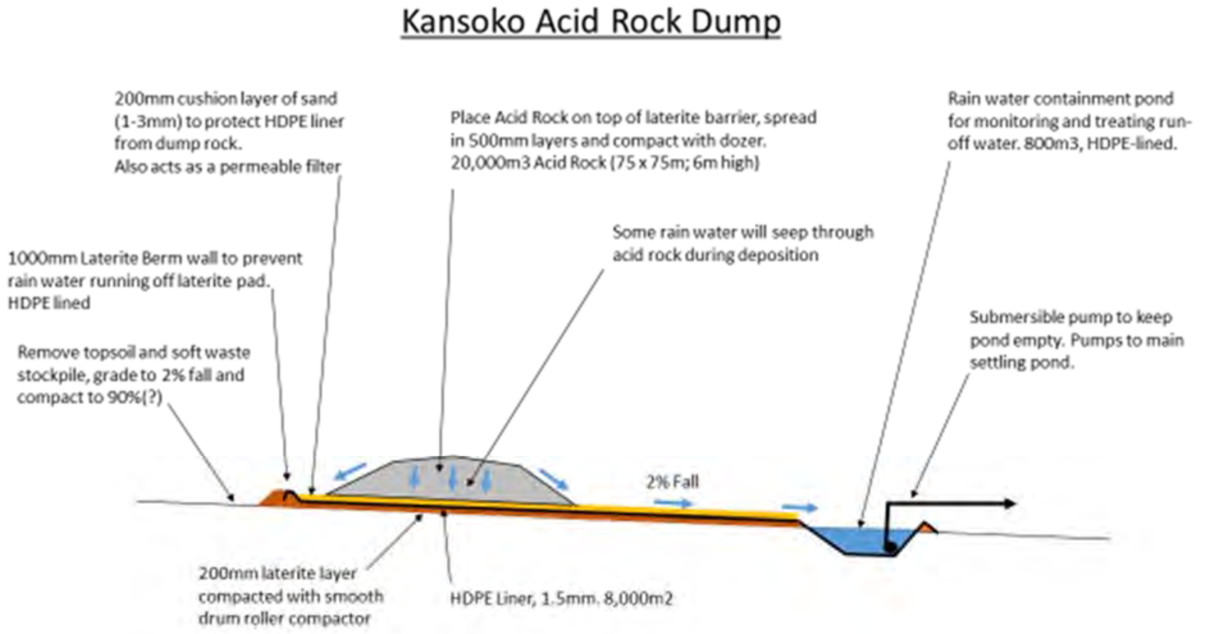
Two waste rock dumps will be developed (one at Kansoko (500 000 m^3 and one at Kakula 200 000 m^3) as detailed in section 3.10.1.

Waste Rock

Based on acid generation potential specified in the DRC Mining Code the KPS and upper diamictite are high risk waste material that may require an engineered barrier to limit impacts on the receiving environment in the vicinity to of the proposed Waste Rock Dump. All other waste sources are classified as low risk and therefore do not need any containment measures and will likely be utilised for road aggregate or tailings wall construction.

Kamoa anticipate that there will be approximately 60,000 tonnes of KPS and upper diamictite waste generated from the Kansoko mine and likely a similar amount from Kakula. The following containment measures are being developed by Kamoa at Kansoko to contain acidic waste rock:

- Temporary acid rock dump (to contain waste rock until the permanent facility is developed);
- Development of a permanent HDPE lined Acid Rock Dump with catchment pond to contain water and seepage arising from the dump (see figures below)



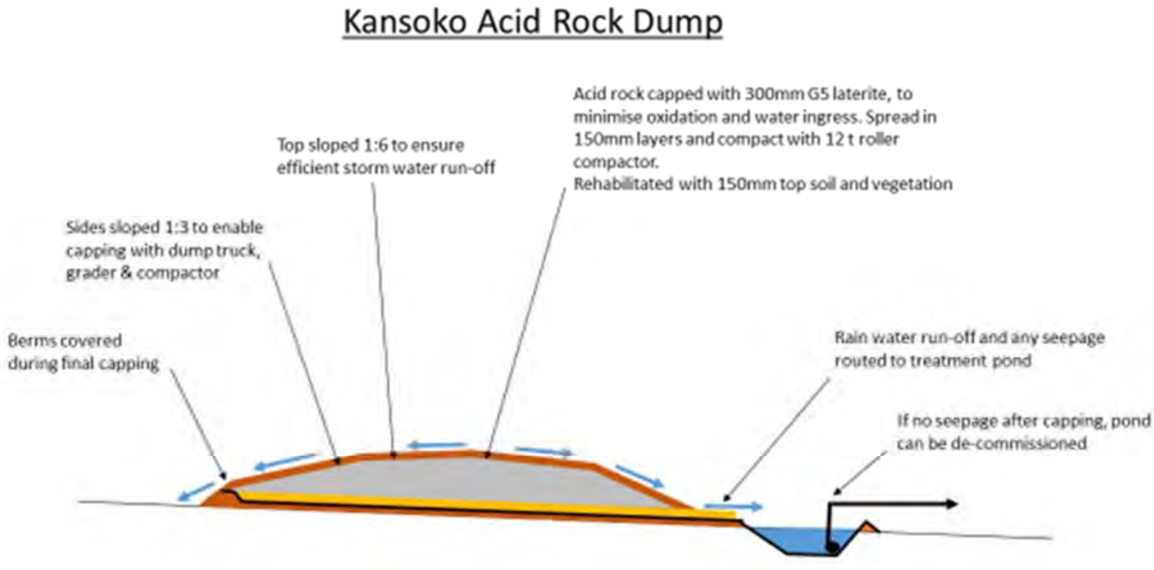


Figure 78: Kansoko Acid Rock Dump Specifications

It should be noted that no irreplaceable aquifers have been identified in the Kansoko or Kakula raeas. A permanent storage solution will be developed in line with the DRC mining code (i.e. a lined storage facility inclusive of leak detection and groundwater monitoring upstream and downstream of the facility as per the Level B impermeability measures).

Tailings

The DRC Mining Code was used to classify the tailings material as high risk or low risk. As the tailings is classified as leachable waste Level A containment measures will be applied to tailings storage. The following process is being undertaken by Kamoa to determine the exact containment measures:

- Geotechnical and hydroegoleogical evaluations of the proposed TSF site are currently being undertaken to determine the permeability of the soils and if there is a hydraulic connection with an underground aquifer. These studies will confirm if any improvements to containment will be required (e.g. soil compaction during site clearance or a form of liner) or if no additional measures would be required.

9.7.9 Description of measures to monitor water quality

Surface Water

The surface water monitoring programme consists of a flow and quality network. Water level measurements commenced in 2010 (December) with eight flow monitoring stations for the baseline studies. The monitoring network was subsequently expanded to include fourteen stations at the end of 2013 and again in 2016 to cover for the Kakula area. Details of the monitoring program are presented in section 5.7.2 and monitoring locations presented in Figure 44.

Groundwater

A groundwater monitoring programme has been in place since 2010 at Kamoa. The monitoring network is being expanded and some boreholes drilled during the current feasibility drilling programme will be incorporated into the monitoring programme and groundwater level and quality baseline. Monitoring locations are presented in Figure 46.

9.7.10 Installation of observation shafts

Groundwater monitoring boreholes will be established around the waste rock dumps and tailings storage facility as per DRC mining code requirements. Specifically

- Monitoring boreholes will be installed upstream and downstream of the TSF and two WRDs as defined by the hydrogeological investigations being carried out; and
- A minimum of three boreholes will be established (one upstream and two downstream) at each WRD and at the TSF.

9.7.11 Frequency of Water Analysis

The frequency of analysis of underground water quality will be four (4) times per year in February, late May-early June, August and late November for the major ions, electrical conductivity and pH.

For the other parameters, analysis results will be undertaken two (2) times per year in late May-early June and August.

9.7.12 Monitoring piezometry

Groundwater depth (piezometry) will be measured on a monthly basis at all boreholes and details recorded.

9.8 Threshold of pollution

9.8.1 Maximum concentration of contaminants in the water

Table 71 below presents the DRC (Article 66 of Annexure IX of Decree No 038/2003) guidelines for effluent discharge into receiving water which will be monitored by Kamoa. Further, Kamoa will compare monitoring data to the effluent guidelines and undertake additional investigation and mitigation should non compliances be identified.

Table 71: Effluent quality Standards and Guidelines for Discharge into receiving waters

Parameters	Units	Maximum acceptable concentration in an instantaneous sample (DRC Law)
Total Suspended Solids	mg/l	100
pH	S.U.	6 to 9
COD	mg/l	
BOD5	mg/l	50
Oil and Grease	mg/l	20
Arsenic	mg/l	0.40
Cadmium	mg/l	-
Chromium (VI)	mg/l	-
Copper	mg/l	1.5
Cyanide	mg/l	2.00
Hydrocarbons	mg/l	10.00
Iron (total)	mg/l	6.00
Lead	mg/l	0.5
Mercury	mg/l	0.002
Nickel	mg/l	1.00
Temperature	°C	Maximum of 5 degrees C from the ambient temperature level of the receiving water and maximum of 3 degrees if the receiving water is > 28 degrees C.
Zinc	mg/l	10

9.9 Water management plan

9.9.1 Calculating the monthly arithmetic mean of final effluent development

Kamoa will calculate the monthly arithmetic mean effluent discharge using the following formula (based on flow rate and analytical data):

"By " monthly arithmetic mean " is meant a mean value calculated for a parameter on the basis of the results of chemical analyses carried out on the samples collected during a month according to the following formula:

X1 + X2 + ... + Xn

Xm= ___________________

nm

where

Xm= monthly arithmetic mean;

*X1,2...n = result of the chemical analysis * measured for each parameter for a sample collected in a single calendar month according to the required frequencies.*

Nm= total number of samples for a single parameter collected in a single calendar month according to the required frequencies.

For calculations of the monthly arithmetic mean, where the result of the chemical analysis of a parameter is below the detection limit, it is necessary to take a value equivalent to one half of the detection limit and add it to the sum of the analysis results for that parameter during that month.

However, where the calculation of the monthly arithmetic mean gives a result below the detection limit for a given parameter, and at least one of the analytical results used for that calculation is above the detection limit, the monthly arithmetic mean is equal to the value of the parameter's detection limit.

If all the analytical results used to calculate the arithmetic mean are below the detection limit for a parameter, the monthly arithmetic mean is equal to one half of the detection limit for that parameter."

9.9.2 Water management plan

Surface hydrological system

Refer to section 5.7 which provides a description of the hydrological system at Kamoa.

Boundaries of the catchment basin

Refer to section 5.7 and Figure 44.

Flows measured in volume/time at the various outlets

Kamoa will install flow monitoring gauges for mine dewatering, process use, clean water and effluent discharge and continuously monitor flow rates as per the water balance already established (refer to section 3.8). The water balance will be updated to reflect any mine changes, to incorporate Kakula and will be set up to continuously record flow information.

Hydrogeology

Baseline hydrogeological information is presented in section 5.8.

Water Balance

Refer to section 3.8 for the mine water balances.

Sanitation Installations

Dedicated sewage and sanitation facilities will be established at each mine site. Kamoa will likely procure and install a Bio Sewage waste water treatment system at each site. This system typically comprises:

- A two stage Septic tank;
- 10,000A bioreactors and clarifier to separate suspended solids;
- Sterilisation tank;
- Ozone Sterilisation System, rendering the entire process chemical free, accommodated within the sterilisation tank; and
- Clean water supply to allow initial filling of the plant during on-site installation, as well as for routine cleaning and servicing of the treatment system.

The system consists of a combination of anaerobic, anoxic and aerobic reactors to achieve an effluent low in dissolved organic compounds as well as low total nitrogen content. The anticipated final effluent quality is within DRC standards as follows (this will be monitored by Kamoa as per section 9.12):

- COD: <75 mg/l;
- Ammonia Nitrogen: <5 mg/l;
- Nitrate Nitrogen: <5 mg/l;
- Faecal coli forms: 500/1 000 ml; and
- pH: <8.5.

Waste Water Treatment System

Currently no waste water treatment system (aside for the sanitation installation outline above) is proposed at Kamoa as current water management measures should result in effluent conforming to DRC effluent discharge quality compliance. Should monitoring indicate non-compliance with effluent quality guidelines, Kamoa will investigate remedial measures and if necessary additional water treatment options.

9.10 Measures to monitor water quality

9.10.1 Description of measures to monitor water quality

Surface Water

The surface water monitoring programme consists of a flow and quality network. Water level measurements commenced in 2010 (December) with eight flow monitoring stations for the baseline studies. The monitoring network was subsequently expanded to include fourteen stations at the end of 2013 and again in 2016 to cover for the Kakula area. Details of the monitoring program are presented in section 5.7.2 and monitoring locations presented in Figure 44. Annual monitoring reports will be issued to DPEM.

Groundwater

A groundwater monitoring programme has been in place since 2010 at Kamoa. The monitoring network is being expanded and some boreholes drilled during the current feasibility drilling programme will be incorporated into the monitoring programme and groundwater level and quality baseline. Monitoring locations are presented in Figure 44 and details of the monitoring program in section 9.7. Annual monitoring reports will be issued to DPEM.

9.11 Frequency and Control of Surface and Underground Water Quality

9.11.1 Water Quality Frequency and Control Program

Water quality monitoring program after site closure

The surface water and groundwater monitoring program will continue as indicated above up until closure when the DRC mining code requirements will be followed and the monitoring program amended to satisfy the specific requirements as listed. The monitoring will be as follows:

- Where waste is still being produced following rehabilitation, a sampling station for that waste will be placed at any discharge point;
- The quality of any surface water flowing from another potential source of contamination will also be checked; and
- Samples will be analysed and the flow rate from discharge points measured as per the frequency and duration given in Table 71

Table 72: Minimum Monitoring Frequency for Groundwater and surface Water – Post closure

LOCATIONS	MINIMUM SAMPLING FREQUENCY	MINIMUM TERM OF MONITORING AFTER SITE CLOSURE
Locations used for management of mine waste :		
1. mines and pits used for management of leachable and cyanided mine waste	2 times per year	5 years
2. mines and pits used for management of acid-producing mine waste	3 times per year	10 years

LOCATIONS	MINIMUM SAMPLING FREQUENCY	MINIMUM TERM OF MONITORING AFTER SITE CLOSURE
3. areas for storage of leachable and cyanided mine waste	2 times per year	5 years
4. areas for storage of acid-producing mine waste	3 times per year	10 years
5. areas for storage of high-risk mine waste	4 times per year	20 years
Locations affected or contaminated by mining activity :		
1. presence of sulphides	3 times per year	10 years
2. any other contaminant	2 times per year	5 years

The post closure monitoring will only be abandoned once*:*

- it is demonstrated that the underground water quality thresholds are not exceeded or intervention is no longer justified.

9.11.2 Annual monitoring parameters and calculation of loads

Kamoa will provide details to DPEM on the annual effluent discharge monitoring parameters as listed in Table 73 inclusive of the pollution loads calculated (monthly load in kilograms (kg) for each parameter of each type of final waste will be worked out by multiplying the result for the monthly mean concentration obtained for a given parameter by the monthly volume of final waste obtained from the mean of measured daily flows multiplied by the number of days rounded to the first decimal point where there has been any flow of final waste during the month. The calculation of the annual loads of each type of final waste is obtained by adding all the results of each parameter's monthly loads for the year under consideration.)

Table 73: Groups of Annual Monitoring Parameters

Groups	Group 1			Group 2	Group 3
	Conventional parameters	**Nutriments**	**Minerals and metallic elements**		
PARAMÈTERS	Alkalinity Chlorides Conductivity DBO_5 DCO Hardness Fluorides Dissolved solids Total solids Phenol substances Sulphates	Ammoniacal nitrogen Total nitrogen, nitrates + nitrites total phosphorus	Aluminium Arsenic Cadmium Calcium Chrome Cobalt Iron Magnesium Manganese Mercury Molybdenum Potassium (Radium 226) Silica Sodium	Cyanates Thiocyanates	Sulphides Thiosulphates

9.11.3 Measurement system for recording flow rate and pH

At all discharge points Kamoa will:

- Set up continuous flow and pH monitoring systems fitted with alarms to indicate and pH non-compliances or excessive flow;
- *Record daily discharge flow in (m^3/h);*
- Maintain and inspect the pH and flow monitors on a weekly basis and calibrate at least annually for flow and weekly for pH; and
- Record all inspections, checks of the accuracy of the pH measuring system, and any adjustments and repairs made at the flow and pH measuring and recording site. The records will contain the following information:
  - (a) the method used to check accuracy; and
  - (b) the accuracy of the flow measuring system after checking the error in flow measurement before checking accuracy and an indication of the cause of the error.

9.12 Frequency and methods of sampling final effluent

The final effluent discharge point at each mine site will be monitored as per Table 74:

Table 74: Frequency of Final Discharge Effluent Monitoring

FRÉQUENCY	3/week	1/week	1/month	Annual
	Total CN (only applicable if CN used in process)) MES pH Flow	As Cu Fe Ni Pb Zn	Acute toxicity	Parameters of groups 1 to 3 (see Table 73)

At the final discharge point, Kamoa will take a sample once per month, on the same day as per the regular surface water monitoring program (Section 9.10) for the monitoring parameters listed in Table 71. Results will be analysed to determine any acute toxicity (native river fish and native river crustacean).

Regularizing final effluent flow

Discharge will be controlled to the extent feasible so that effluent discharge flow is maintained at a constant level r if stored for long periods of time, discharged over a longer period of time as possible to allow for the maximum assimilative capacity of the receiving waters.”

10.0 MANAGEMENT OF SOILS

Kamoa will implement the following procedure for the management of soils stripped for the purpose of the development:

Topsoil and Subsoil Identification

It is important to understand the nature and depth of the topsoil and subsoil that will be cleared in order to develop the most effective soils handling, storage and replacement process. Mixing of the subsoil and topsoil layers can lead to deterioration in soil fertility and quality resulting in poor rehabilitation, therefore it is important to have a full understanding of topsoil and subsoil depths in areas to be cleared. Kamoa will therefore apply the following procedures:

- Clearly define soil types, areas of soil to be stripped, haul routes and stockpile locations on a map;

- Topsoil and subsoil depth will be determined prior to site clearance, through a minimum of 1 soil pit per hectare of land to be cleared and separate stockpiles provided with no mixing of subsoil and topsoil allowed; and
- Clear instructions will be developed to indicate to the earthmoving contractor(s) the depth of clearance for each specific site.

Topsoil stripping

Before commencing work on site, topsoil from all areas that are to be disturbed by construction activities or driven over by vehicles will be stripped by earthmoving plant that is appropriate to the size of the site, soil conditions, the volume of soil to be stripped and haul distances. Process is as follows:

1) Remove surface vegetation by blading off, by scarification and raking, or by cutting down for timber to be donated to the local community. No use of fire permitted.
2) Stripping should be undertaken by the excavator standing on the surface of the topsoil, digging the topsoil to its maximum depth and loading into site or off-site transport vehicles.
3) Topsoil is to be placed in Topsoil stockpiles.

Subsoil Stripping

Topsoil should first be stripped from all areas from which subsoil is to be removed for reuse.

Within each soil unit the soil layers above the base/formation layer are removed in sequential strips that can be up to 6 m wide (the reach of a 360° excavator). Using an excavator bucket with teeth is preferable to using one without. Where there is a cover of topsoil, that layer is removed first before stripping subsoil to the specified depth.

Subsoil to be placed in subsoil stockpiles and not mixed with Topsoil.

Adverse Weather

If sustained heavy rainfall (e.g. >10 mm in 24 hours/large scale storm events) occurs during soil stripping operations, work must be suspended and not restarted until the ground has had at least a full dry day or agreed moisture criteria (such as a specified soil moisture content) can be met. Lighter soil (e.g. free draining sandy soil) can generally be moved at higher moisture content with less risk of damage when compared to a heavy soil (e.g. clayey soil).

Key Points

- Strip topsoil in the driest condition possible;
- Use tracked equipment wherever possible to reduce compaction;
- Confine movement of trucks or dumpers to designated temporary haul routes; and
- Keep subsoil and topsoil stockpiles separate.

Soil Stockpiling

Soil will be stored in an area of the site where it can be left undisturbed and will not interfere with site operations but close enough for ease of use for concurrent rehabilitation. Ground to be used for storing the topsoil should be cleared of vegetation and any waste arising from the development (e.g. building rubble and fill materials).Contractors will clearly indicate where topsoil and subsoil stockpiles will be located:

- Different stockpiles will be developed for subsoils and topsoils;
- The Environmental Department will map and estimate amount of topsoil and subsoil stored at stockpiles; and
- Topsoil will first be stripped from any land to be used for storing subsoil.

Subsoils and Dry/Non Plastic Soils

All Arenosols in the project area are not plastic because of their low clay content (less than 10%). Nevertheless, the presence of the conglomerate material underlying the Kalahari sand deposit, there is waterlogging in the DILUNGU area during the rainy season; Plinthic Alisols, P, Haplic Podzols and Ferralsols Arenic with sand or loamy sand materials are not plastic. The following handling and storage process will be undertaken for these soils:

- The soil is loose-tipped in heaps from a dump truck;
- When the entire storage area has been filled with heaps, a tracked machine (excavator or dozer) levels them and firms the surface in order for a second layer of heaps to be tipped;
- This sequence is repeated until the stockpile reaches its planned height (<2 m for topsoils and <4 m for subsoils); and
- To help shed rainwater and prevent ponding and infiltration a tracked machine compacts and re-grades the sides and top of the stockpile to form a smooth gradient.

Wet Plastic Soils

Cambisol are the wettest plastic soils because of the high clay contain (around 40% clay). Whereas, all Plinthosols, Acrisols , Alisols Epydistric, Ferralsols Rhodic , Haplic Ferralsols, Haplic Cambisols and Plinthic Cambisols are wet plastic with sandy clay loam texture. For these soils the following handling and storage will be undertaken:

- The soil is tipped in a line of heaps to form a ‘windrow heap’, starting at the furthest point in the storage area and working back toward the access point;
- Any additional windrows are spaced sufficiently apart to allow tracked plant to gain access between them so that the soil can be heaped up to a maximum height of 2 m;
- To avoid compaction, no machinery, even tracked plant, traverses the windrow heap;
- Once the soil has dried out and is non-plastic in consistency (this usually requires several weeks of dry and windy or warm weather), the windrows are combined to form larger stockpiles, using a tracked excavator; and
- The surface of the stockpile is then regraded and compacted by a tracked machine (dozer or excavator) to reduce rainwater infiltration.

Stockpile location and stability

Stockpiles will not be positioned within the root or crown spread of trees, or adjacent to ditches, watercourses or existing or future excavations. Soil will have a natural angle of repose of up to 40° depending on texture and moisture content but, if stable stockpiles are to be formed, slope angles will normally need to be less than that.

For stockpiles that are to be grass seeded and maintained, a maximum side slope of 1 in 2 (25°) is appropriate.

Stockpile protection and maintenance

Once the stockpile has been completed the area will be cordoned off with secure fencing to prevent any disturbance or contamination by other construction activities. If the soil is to be stockpiled for more than six months, the surface of the stockpiles will be seeded with a grass/clover mix to minimise soil erosion and to help reduce infestation by nuisance weeds that might spread seed onto adjacent land.

Inspections

Soils stockpiles will be inspected monthly during construction as part of Environmental site audits.

Environmental audits will:

- Verify contractor compliance with topsoil and subsoil removal and stockpiling; and
- Provide instructions for improvements.

Annual soil fertility monitoring at stockpiles will be carried out as follows:

- Visual examination – soil structure, consistency, foreign matter, etc;
- Particle size analysis (texture) and stone content;
- pH and salinity values;
- Content of major plant nutrients;
- Organic matter content; and
- Maximum levels of potential contaminants (e.g. heavy metals and hydrocarbons).

Annual report to be produced with recommendations for soil stockpile maintenance.

Soil Re-Placement

To replace soils for rehabilitation the following will be undertaken

The loose-tipping method (topsoil spreading only)

a) loosen the subsoil of the receiving ground;

b) load topsoil from stockpile;

c) backtip topsoil onto loosened subsoil;

d) level topsoil; and

e) Revegetation using indigenous seeds.

The loose-tipping method (topsoil and subsoil spreading)

a) loosen the substrate of the receiving ground;

b) load subsoil from stockpile;

c) backtip subsoil onto loosened substrate;

d) level subsoil;

e) backtip topsoil;

f) spread topsoil over subsoil using excavator working on substrate; and

g) Revegetation using indigenous seeds.

Topsoil Thickness

Topsoil placement thickness will depend on the anticipated rooting depth of the plants to be established and the quality of the underlying subsoil. Trees and shrubs require a much greater rooting depth than grasses, though this does not have to be made up entirely of topsoil. Topsoil at least 150 mm deep is desirable for grass and can beneficially be placed more deeply (up to a maximum of 400 mm thick) for trees and shrubs.

Topsoil cultivation

After re-spreading topsoil, any large, compacted lumps should be broken down by appropriate cultivation to produce a fine tilth suitable for planting (<50 mm maximum aggregate size), turfing and seeding (<10 mm maximum aggregate size).

Topsoil that has been stored in a stockpile is often compacted and anaerobic. It should therefore be cultivated to its full depth using appropriate tillage equipment to decompact and fully re-aerate. Only when the topsoil has been fully re-aerated will it be satisfactory for planting, turfing or seeding. More than one cultivation may be required to re-aerate the entire thickness of topsoil. Undesirable material (e.g. stones, fill materials and vegetation larger than 50 mm in any dimension) brought to the surface during cultivation should be removed by picking or raking.

Soil Aftercare

Following topsoil placement the following should be undertaken:

- Soils should be monitored twice per year to determine soils conditions (i.e. anaerobic, rotting) to determine if additional soils treatment is required.

Surplus Soils

Should soils be in surplus – they should be stockpiled adjacent to the Tailings Storage Facility (TSF) and Waste Rock Dump (WRD) for use in concurrent rehabilitation activities.

Sourcing and Importing Topsoil

If no topsoil is available for rehabilitation works, it may be necessary to source topsoil from outside sources. Prior to any sourcing of topsoil a full investigation and assessment will be carried out considering:

- Sourcing Natural topsoil from borrow pit areas and development;
- Manufacturing soil on site; and/or
- Obtaining natural soils from licenced contractors.

10.1 Total volume of Soils to be stockpiled

Once final planning has been completed the total volume of topsoil and subsoil to be stockpiled will be determined.

10.2 Backfill

Mine backfill is currently not being considered by Kamoa. Should backfilling become an option the following information will be supplied to DPEM:

- the type of infilling planned, in particular hydraulic or some type of compound;
- the composition of the waste and additives, if any, used for the underground infilling;
- the amount of materials or waste buried; and
- a demonstration of the long-term harmlessness of the compound infilling material in order to attenuate any impact on the underground water and pumping water. “

10.3 Management of mine waste

10.3.1 General conditions relating to mine waste

As indicated in section 3.3.5, during the first years of mining at each mine site, or when suitable locations underground are not available, small amounts of waste may need to be stored in waste dumps located near the mine access portals. It can be noted that typically only box cuts, initial declines and vent shafts are in waste, this will amount to typically 500,000 m^3 at Kansoko and 200,000 m^3 at Kakula and is minimal. A small amount (60,000 kt) of acid rock will be generated from the Kansoko decline shaft development) which will be specifically stored and encapsulated to minimise any risk.

Waste rock will be utilised as aggregate material (for road building and plant terracing) and for the construction of the purpose built TSF. All remaining waste rock will remain underground as random gob fill or for construction of ventilation control barriers.

The waste rock dumps will be developed utilising the following design and maintenance principles:

- Appropriate terrace and lift height specifications based on the nature of the material and local geotechnical considerations to minimize erosion and reduce safety risks;
- Ensuring that potential changes of geotechnical properties in dumps due to chemical or biologically catalysed weathering are monitored;
- Placing a proper cover system, which would prevent precipitation from percolating into the dump's body for closed waste rock dumps which are not required for future mine development;
- Appropriate factors of safety; and
- Wind erosion reduction measures (e.g. through concurrent rehabilitation of closed areas and establishing perimeter vegetative screens).

10.3.2 Conditions specific to each type of waste

Acid-producing mine waste

As indicated above, Kamoa anticipate that there will be approximately 60,000 tonnes of KPS and upper Diamictite waste generated from the Kansoko mine and likely a similar amount from Kakula. The following containment measures will be applied for these materials:

- A compacted laterite pad with berms will be constructed on top of the existing waste rock dump at Kansoko and the proposed waste rock dump at Kakula to contain the acid rock and minimise potential acid seepage;
- Once dumping of the KPS and upper diamictite waste has been completed Kamoa will cap it with compacted top soil to reduce oxidation and water ingress; and
- Groundwater around the WRD will be monitored and runoff from the WRD will be collected and monitored.

It should be noted that no irreplaceable aquifers have been identified in the Kansoko or Kakula areas. A permanent storage solution will be developed in line with the DRC mining code (i.e. a lined storage facility inclusive of leak detection and groundwater monitoring upstream and downstream of the facility as per the Level B permeability measures).

10.3.3 Mine waste storage areas and yards

Tailings Storage

Specific environmental protection measures for the TSF will include:

- The preparatory works associated with the TSF currently anticipated to comprise the following (EPOCH, 2016):
  - Topsoil stripping, handling and storage for future rehabilitation to a depth of 300 mm beneath the TSF footprint;
  - A box cut to a depth of 500 mm beneath the starter wall embankment;
  - A compacted key below the Phase 1 wall embankment comprises the following:
    - Depth required shall be deep enough to remove the Kalahari sands layer;
    - 10.0 m wide;
    - 1V:1.5 H side slopes; and
    - 3.5 m wide compacted bentonite-enriched earth layer to prevent excessive seepage under the wall.

- A compacted earth starter wall embankment;
- A Curtain Drain inside the impoundment wall, to reduce the phreatic surface through the wall. This will comprise the following:
  - Starting 1 m below the top of the wall, ending at the base of the wall and 1 m wide. This will comprise of filter material;
  - A 160 mm perforated pipe at the base of the curtain drain;
  - A 160 mm non-perforated outlet pipe, conveying water out of the wall; and
  - A 300 mm non-perforated pipe to convey water to the RWS.
- Manholes at each outlet pipe to monitor the drain flows;
- A storm water run-off trench and berm around the TSF from which water is directed away from the TSF. The trapezoidal solution trench has the following dimensions:
  - 1.0 m deep;
  - 1.0 m wide; and
  - 1V:1.5H side slopes.
- A storm water diversion channel with its associated cut-to-fill berm wall with the following dimensions:
  - 1.0 m deep;
  - 1.0 m wide; and
  - 1V:1.5H side slopes.
- A buried 900 ND Class 150D spigot-socket precast concrete penstock pipeline composed of single intermediate intakes and a double final vertical 510 ND precast concrete penstock ring inlet;
- A 1500 micron liner along the bottom of the valley and approximately 200 m wide, in order to prevent tailings water seeping through the highly permeable Kalahari sands;
- A 450 ND slurry spigot pipeline along the length of the TSF impoundment wall; and
- A two-compartment reinforced concrete Return Water Sump (RWS).

During operations the TSF will be managed to DRC standards, with supernatant returned to the process at Kakula and Kansoko. Refer to section 3.8 for the tailings water balance. Emergency measures for tailings breach are presented in section 12.2.1.

Containment systems

Refer to section 9.7 for a description of the proposed water containment systems.

Tailings and Waste Rock Geotechnical Stability and Water Management

Structural Stability

As per Annex XIV of the mining code Kamoa will ensure that the final designs of the TSF and Waste Rock Dumps take into account the following:

- Site investigation techniques: for determining the properties of materials such as backfill, foundations and other structures, as well as methods to put such structures in place and compacting methods must be carried out in accordance with state of the art methods;

- Appropriate stability calculations must be undertaken and shall take into consideration long-term conditions that might affect structures, including static and dynamic loads;
- An appropriate seismic coefficient must be used for the seismic stability analyses i.e. a seismic coefficient with an annual probability of exceedance of 1 in 476 years (10% over a period of 50 years) for sites with non-acid generating material, and an annual probability of exceedance of 1 in 1 000 years for sites with acid generating material;
- The slope stability's factor of safety should be greater than 1.5 for static stability analyses, and between 1.1 and 1.3 pseudo-static analyses;
- Appropriate measures must be taken to ensure that no toxins from any tailings storage areas enter into the groundwater. Different requirements are applicable depending on the geochemical nature and toxicity of the tailings product; and
- Surface erosion problems shall be controlled by preferably planting vegetation. Erosion problems in unconsolidated materials shall be eliminated by reducing the hydraulic gradient. If materials of different particle grading's are placed in contact with each other, appropriate filter criteria must be observed.

Topographical Plans

Refer to Figure 25. Topographical plans are currently being developed for the WRDs.

Final slopes

The final slopes of the TSF are indicated in Figure 26, and are designed to allow for the safety factors adopted as well as for concurrent rehabilitation (see section 10.3). Final waste rock dumps (if they exist) will be designed to allow for cover placement and vegetation of the side walls using available subsoil and topsoil covers.

Flood water management systems

Flood water management systems for the TSF and Waste Rock Dumps are presented in section 10.3.

Water Balances

The water balance established for the project which includes the TSF is indicated in section 3.8.

Cover Parameters and Monitoring

A minimum cover of Topsoil of at least 150 mm deep will be placed on the TSF at closure from maintained stockpiles located around the TSF. Monitoring of the cover and rates of vegetation will be monitored as part of the closure monitoring proposed in section 13.0.

Maintenance requirements

Specific maintenance and operational procedures are currently being developed for the TSF. Geotechnical stability monitoring and ongoing maintenance will be included in the general procedures for Waste Rock Dump maintenance.

10.3.4 Measures required for rehabilitation of mine waste depots and dependent infrastructure

Specific rehabilitation works for the TSF and Waste Rock Dumps are described in section 13.9.

10.3.5 Erection of water retention structures

Flood retention structures for the TSF are described and presented in section 10.3.

10.3.6 Monitoring stability of structures

All structures at Kamoa inclusive of underground infrastructure and surface subsidence will be monitored on an annual basis of following exceptional climatic events by a geotechnical engineer. All records will be retained and corrective measures implemented as required to ensure the safety of the structure.

10.4 Management of chemical products, solid waste and dangerous waste

10.4.1 Attenuation measures relating to chemical products

List of the chemical products

The following chemicals are anticipated to be used at Kamoa:

Table 75: Chemical to be used at Kamoa

Item	Description	Annual Requirement – 4Mtpa	Annual Requirement – 2 x 4 Mtpa (8Mtpa)
Reagents	Frother (Senfroth)	380 t	760 t
	Collector (SIBX)	624 t	1248 t
	Promoter (Cytec 3477)	112 t	224 t
	Flocculant (Tailings and Concentrate) (Magnafloc 10)	140 t	280 t
Explosives	Emulsion	To be confirmed	To be confirmed
Fuel	Diesel	To be confirmed	To be confirmed
	Petrol	To be confirmed	To be confirmed
Oil and Lubricants	Oil	To be confirmed	To be confirmed

All the above chemicals will be transferred and stored in dedicated facilities as per their corresponding MSDS (see APPENDIX B). A brief description of how these chemicals and reagents are used is given below:-

- Collector – mixed as a 25% solution and transferred to a storage tank where it is dosed via small dosing pumps and multi-stage dosing tank to the flotation circuit addition points as required;
- Promoter – will be transferred to a small holding tank from 200 lt drums and added as is to the circuit using small dosing pumps;
- Frother – will be transferred to a small holding tank from 200 lt drums and added as is to the circuit via small dosing pumps and the newly installed multi-stage dosing tank; and
- Flocculent – will be pumped by dosing pumps to the flotation tailings thickener; and the concentrate thickener.

Blasting is currently being carried out in closely spaced drill patterns. The explosive types and detonators used are: -

- Anfo Emulsion Explosive Blend;
- High Explosion Boosters; and
- Non-electric detonators (NONEL, EXEL etc.).

All explosives are stored in a secure storage building on-site. The storage building is locked and the store has 24-hour security. Security is provided by a registered Congolese company.

Fuel and oil will be stored by the supplier in dedicated facilities fitted with impervious flooring and bunding as well as safety and environmental protection aspects to conform to DRC standards.

Location and a description of the storage sites

The location of the storage sites are still being determined for development.

Type of soils underlying the storage sites

Types of soils underlying the project infrastructure are presented in section 5.1.3. Appropriate engineering measures as well as impervious flooring, bunding and spills procedures will be established to protect the soil from potential contamination.

Final inventory of stored products

An inventory of all stored products will be established during final mine planning maintained by the mine stores manager.

Terms and conditions of storage

All the above chemicals will be transferred and stored in dedicated facilities as per their corresponding MSDS (see APPENDIX B).

Elimination method(s)

Any spent or expired chemical will be returned to the manufacturer for re-use or safe disposal.

10.4.2 Measures relating to solid waste

Industrial Waste Generation

Significant quantities of scrap metal and empty containers will be generated. These will be sold or recycled to minimise the amount stored at the mine. All the industrial waste will be stored in secure areas. The materials will be sorted to facilitate reuse/recycling.

Scrap metal dealers and used equipment dealers will be encouraged to remove waste materials. Reusable materials such as empty drums, used conveyor belts and timber will be reused by the mine, sold or given away. Used tyres will be painted by the mine and used to mark the edges of roads, bends, operational areas and accident black spots.

Waste Separation

General waste generated onsite (wood, plastic and organic waste) will be separated on site. Different coloured and labelled bins will be provided in appropriate areas.

Waste will be re-used where possible on or off site i.e. organic waste composted and wood waste re-used for construction or conversion into sawdust for oil spill absorption.

Waste that cannot be re-used or recycled will be disposed of in a landfill site within the mine area. The landfill site will be approximately 50 m^2 in area and waste dumped here will be compacted.

10.4.3 Measures relating to dangerous waste

Hazardous Waste Generation

Hazardous waste such as oils and grease will be stored in a secure area. The area will be covered, have a concrete floor and 110% containment capacity. Sawdust that is used to clean up oil and grease spills will be contained in a secure area and mixed with a small amount of organic material and soil in order to encourage the bio-remediation of the contaminated sawdust. The success of the bio-remediation system will be reviewed annually through an annual hydrocarbon monitoring campaign. Non-compatible hazardous waste will be stored at separate sites. Used oil will be sold to a recycling company and greases returned to supplier or incinerated according to approved disposal practices.

Medical Waste Generation

Medical waste from the mine clinic may cause contamination if not handled and disposed properly. All medical waste will be incinerated in an approved incinerator.

11.0 OCCUPATIONAL HEALTH AND SAFETY

Kamoa has in place an Occupational Health and Safety Management System (OHSMS) for its construction and operation phases. This system uses a risk based approach to determining specific health and safety risks for all activities and operations with the development of specific measures, programs and procedures for the management of those risks. Prior to any activity or development a health and safety risk assessment is carried out and specific controls established prior to undertaking any such activity. Kamoa is committed to identify the activities, products and services that can any health & safety risks and sets priorities for action to reduce these risks.

The Occupational Health & Safety (OHS) Manager will maintain records of all significant OHS matters, including but not limited to accidents, monitoring data, occupational illnesses, spills, fires and other emergencies. This data will be used to evaluate and improve the efficiency and effectiveness of the occupational health and safety programme.

11.1 Monitoring air quality and temperatures

11.1.1 Underground Ventilation

A number of dedicated ventilation shafts are planned to provide fresh air to workers and equipment at both underground mining areas. The location of these shafts are provided in Figure 4. A detailed ventilation plan is under development to address the ventilation requirements in the different mining sections and to better define the intake and exhaust raise requirements. Workers will be provided with emergency respirator equipment and there will be dedicated rescue bays within the underground mining sections with secure oxygen supply for emergency situations. Workers will be fully inducted and trained on the use of emergency systems prior to working underground.

Air quality Monitoring

In addition to the air monitoring outlined in section 9.5, good ventilation will be provided in the workplace. The condition of protective respiratory equipment and air quality monitoring equipment will be routinely checked and maintained, as well as any warning systems.

Protective respiratory equipment will be provided and worn by all employees when exposure to welding fumes, solvents and other substances are present in the workplace or exceed statutory limits. Respiratory protection will be worn at all times in dusty environments and when air monitoring data, indicates that respiratory protection is required. Dust masks will be issued to all employees working in areas where particulates (inert or nuisance dusts) may exceed the statutory limit of 10 mg/m^3.

Safety officers will conduct routine inspections to ensure the appropriate respiratory protection equipment is in good working condition and being used correctly.

Thermometers will be installed in areas where high heat and humidity occur to ensure there are no detrimental effects on employees. Employees working in areas of high temperature and humidity will be allowed regular breaks and be provided with sufficient water.

11.2 Monitoring noise

All plant equipment belonging to the mine and to contractors will undergo routine maintenance to ensure it is in good working order and to minimise noise levels.

Where it is practical and feasible to do so, Kama will install sound-insulation and control rooms to decrease the average noise level exposure in normal work areas.

Kamoa will adopt the DRC standard of 85 decibels (dB) for exposure of its employees to noise over an 8-hour shift. Employees will wear appropriate ear protection in workplaces where noise levels exceed 85 dB.

Safety officers will monitor noise levels using level 1 sound meters, will identify noisy areas, provide clear signage that hearing protection is needed and further will monitor the use of protective equipment to ensure the appropriate and correct use of the protective equipment by employees.

11.3 Work in a cramped space

Entering into confined spaces such as tanks, vessels, sumps and excavations to carry out inspection, repair and/or maintenance can expose workers to the danger of toxic, flammable or explosive gases. These spaces must be tested for the presence of gases or lack of oxygen, and adequate ventilation provided before and during occupancy.

Employees working in confined spaces, which may become contaminated or deficient in air, must wear appropriate air-supplied respirators. Suitably equipped observers must be stationed outside confined spaces to provide emergency assistance if required to people working inside.

11.4 Dangerous products and mine waste

All hazardous (reactive, radioactive, corrosive and toxic) materials or substances will be stored in appropriate and clearly labelled containers or vessels in strict accordance with their relevant Materials Safety Data Sheets (MSDS). Fire protection systems and secondary containment will be provided in the storage area to prevent fires or the release of hazardous materials to the environment.

The transfer, storage and handling of hazardous materials will be carried out in accordance with the DRC Mining Regulations and Kamoa's Materials Handling Procedures.

Kamoa will provide well-equipped sanitary facilities for its employees. Workers will be encouraged to wash or shower frequently, particularly those employees exposed to dust, chemicals or pathogens.

Emergency Fire and Rescue Mitigation and Management

The water supply for fire-fighting will be capable of providing the required firewater flows for any combination of hydrant-monitors, sprinkler systems, standpipe systems, deluge systems and responding to fire apparatus based on a single fire event. The fire water distribution system shall be designed to supply the specified rate to each fire hazardous area. The firewater system, including connections to the system, will be designed to provide a high degree of reliability. Connections to the firewater system for any other service will not be acceptable.

Fire hydrants shall be located when the plot plans for each mine site have been finalised. Hydrants shall be 'industrial standard'. Hydrants shall be located on the roadside of all pipelines and drainage ditches and shall not be located within diked areas for tanks. Hydrants shall be located within 6m of the roadway.

Hose reels should be placed on each equipment structure platform level and distributed inside process buildings wherever fire hazardous equipment is located. At least one hose reel is required per 1,000 m^3 of plant area.

Deluge systems shall be considered for:

- Pumps handling flammable liquids;
- Lube oil consoles for critical equipment;
- Transformer bays;
- Flammable liquid storage areas; and
- All other hazardous materials areas.

Placement of hand extinguishers shall meet prescribed specifications. Hand extinguishers to be placed in fire hazardous process areas, non-fire hazardous process areas, electrical rooms, non-process buildings, control rooms, and all company vehicles for each mine site.

Fire detection equipment shall include a Fire Indicator Panel (FIP) located in the Main Control Room area and local intelligent units or Sub Fire Indicator Panels (SFIP) as required located around the site.

The total control and indicating equipment shall be arranged as a distributed system preferably interconnected by a single communications and power loop on a loop-in loop-out basis at each device to minimise site wiring requirements.

The Fire Detection System will be independent of the Process Control System (PCS) and shall be specified as part of the overall Fire Protection System for the plants, which shall include the Fire Water System and Inert Gas Suppression Systems.

11.5 Traditional safety measures

Road Safety

The general safety of employees whilst driving and operating company vehicles and machinery is the responsibility of Kamoa, except in cases where the employee acts in a negligent and dangerous manner.

Hazard signs will be erected or posted around the plant and mine site road infrastructure to warn employees and contractors of potential dangers on the roads.

Road safety and awareness programs will be provided detailing the rules and regulations for the operation of vehicles and machinery, including speed limits within the Project perimeter.

Random breath-testing for the presence of prohibited substances whilst on duty will be mandatory.

Regular, randomly positioned speed traps will be used to control and monitor company drivers.

Contact telephone numbers of persons and services to be notified in the event of an emergency will be circulated to the workforce.

Mine Safety

The general safety of employees while at work is the responsibility of Kamoa except in cases where the employee acts in a negligent and dangerous manner.

Conveyors and similar machinery will be provided with a means of stopping them at any point. Guards will be fitted to all drive belts, pulley, gears and other moving parts to protect workers. Raised platforms, walkways, gantries, scaffolds, stairways and ramps will be equipped with handrails and non-slip surfaces. All electrical equipment will be earthed, well insulated and conform to applicable codes. Plant site piping will be colour-coded for acid, water, compressed air, process solution etc.

Mine employees will be provided with hard-hats, safety boots, overalls, ear and eye protection, dust masks and gloves as appropriate as well as specific underground PPE such as lamps, reflective overalls, rescue equipment and related aspects.

The Mining Explosives Regulations governing the safe storage, handling and transport of explosives to, in and around the mine will be strictly enforced. Only qualified and certified personnel will be allowed to carry out blasting operations.

Hazard signs will be erected or posted around the plant and mine site to warn employees and contractors of potential dangers.

Contact telephone numbers of persons and services to be notified in the event of an emergency will be circulated to the workforce.

Accidental oil/fuel/chemical/reagent spills

Training will be given to employees handling oils, reagents and chemicals focusing on potential risks, safe handling procedures, safety precautions, first aid, emergency response and appropriate disposal practices.

Material Safety Data Sheets (MSDS) will be obtained by Kamoa for all the chemicals used on the site. These sheets will specify hazards, compatibility with other substances, and specific handling, storage or disposal requirements. The end users will have copies of the relevant MSDS and receive training on the hazardous substances used in their area of operations.

Mine Site – unauthorised access

Both mine areas will be fenced off and access controlled. Hazard signs will be erected or posted around the plant and mine site to warn employees and contractors of potential dangers and prohibited areas.

Employee Training

A safety and environmental induction will be carried out for new employees, contractors and for any person arriving on site after a break exceeding two weeks. The safety induction will cover the use of personal protective devices, dangerous areas, appropriate conduct, emergency response procedures and waste management. The induction will be compulsory for all persons entering the site.

Employees will receive training regarding safety, health and environmental matters including accident prevention, safe lifting practices, correct use of MSDS, safe chemical handling practices, and proper control and maintenance of equipment and facilities. This will aid in the prevention of work-place accidents.

Employees will receive specific training from accident-prevention and safety officers concerning precautions and procedures for the safe storage, handling, transport and use of potentially harmful materials. The training provided will include key information from the MSDS for potentially harmful material and substances. This will aid in the prevention of accidents or chemical spills.

Training will be given on emergency response systems and procedures, including the location and proper use of emergency equipment, use of personal protective equipment, procedures for raising the alarm and notifying emergency response teams, and the proper response actions for each foreseeable emergency situation. Daily safety and environment briefings, including inspections of personal protective equipment, will be conducted by relevant supervisors or shift bosses.

Working at Height

Wherever reasonably practicable, preference will be given to the performance of work at ground level as opposed to in an elevated position. Where work in an elevated position is necessary, preference will be given to fall prevention measures such as, but not limited to, effective barricading and the use of work platforms. Persons may only work from a fall risk position if a site-specific fall protection plan is in place and correctly implemented and consists of the following:

- Risk assessments conducted which are specific and incorporates the working at height risk assessment, as well as the site-specific risk assessment, and are completed for the work to be conducted;
- Safe working procedure/task analysis and work instructions, approved by a competent person, are in place;
- A fall rescue plan, along with necessary equipment and trained rescuers, is in place.
- Appropriate training, as determined by the risk assessment, has been provided;
- Appropriate height safety equipment and personal protective equipment have been issued to the individual; and
- Individuals are medically fit to work at height, and records of this are kept. A site-specific risk assessment is performed.

While work is in progress, adequate warning signs and/or barricades shall be used in all areas where there is a risk of persons being injured by materials or equipment falling from the work area. Barricades should be continuous and easily visible. A drop zone shall be established with appropriate warning signs and barrier tape or barricading, warning personnel below of workers above and potential falling objects

Electrical Safety

For electrical activities Kamoa a safe electrical clearance procedure will be established during any electrical installation and the provisions for tagging; lock out and capping of controls shall be followed during the operation and maintenance of the electrical equipment.

Safety Sanctions

Any contravention of safety standards by employees or contractors will result in the application of sanctions as defined in the Kamoa code of conduct.

12.0 COMMUNITY HEALTH AND SAFETY

12.1 Measures relating to health

Medical care installations

Each mine site (Kakula and Kansoko) will have a dedicated clinic. The clinic will includes the following:

- Medical treatment room;
- Recovery room;
- Waiting room;
- First aid room;
- Doctor’s office;
- Nurse’s office;
- Office for duty officer;
- Emergency services officer office;
- Store room; and
- Ablutions.

Each site will have an emergency response vehicle, and trained medical staff to deal with minor accidents.

Medical equipment, medications and vaccines

Each mine clinic will contain the required equipment, medication and vaccines as determined by the Chief Medical Officer to enable the provision of general health care and emergency stabilisation prior to evacuation for medical emergencies.

Medical personnel

Each mine site medical team will consist of a dayshift crew comprising of a trained doctor and nurse. The nearest hospital facility is located on hour 30 minutes’ drive away in Kolwezi. Any personnel with minor injuries or illnesses requiring overnight hospital treatment are transported by the site ambulance directly to the hospital.

Program for preventing sickness and epidemics

Medical Check-ups

Kamoa will provide an onsite medical facility to deal with routine healthcare needs and medical emergencies. The medical facility will be equipped with medical material, medicines and vaccines and will be adequately staffed for the planned workforce.

Pre-employment and regular medical examinations will be carried out on all mine employees.

Health and safety statistics will be reported at Kamoa management meetings and included in the company's annual environmental reports.

Respiratory Diseases

The presence of large amounts of dust in the air may lead to respiratory infections and/or exacerbate existing respiratory diseases. The Project working practices have the potential to create significant amounts of dust, especially in the underground mining environment.

It is recommended that all employees, even those working in offices, are provided with face-masks, which should be worn by operators and other staff for their convenience.

It is recommended that the Project conduct regular monitoring of the levels of dust at the homes of residents, including those residents living close to ungraded access roads providing access to the project.

Disease Transmission

Malaria

The baseline study showed that malaria is one of the biggest causes of illness and mortality in the Project area. Regionally Ivanhoe Mining, Kamoa's parent company, is providing support to the DRC's National Malaria Control Program (PNLP). Ivanhoe in collaboration between Fio, Chemonics and the Ministry of the Health are supporting activities under the PNLP in 300 healthcare facilities over three years in Haut-Katanga and Lualaba Provinces. The support specifically involves the roll out of Fionet, a solution developed by Fio to help frontline health workers improve the quality of care that they deliver to individual patients while automatically capturing data that is critically needed to strengthen health systems as a whole. The data that the Ivanhoe-Fio Project captures will help provincial and national governments strengthen disease surveillance and the management of malaria control activities in the DRC. On site Kamoa will develop an integrated workplace malaria and vector control programme based on integrated pest management principles.

Water Sanitation and Hygiene

Water, hygiene and sanitation related conditions are a significant prevailing public health concern. There are no improved water sources available in the community and access to sanitation facilities is very limited. Open defecation is common and personal hygienic is described as poor. Diarrhoeal diseases and conditions such as intestinal parasites are reported to be common. Cholera and dysentery outbreaks are a real possibility around Kamoa and there is limited institutional capacity to manage an outbreak. Kamoa will Support integrated water, hygiene and sanitation programmes in the study area as part of the Sustainable Development Plan.

HIV/AIDS

Increasing rates of sexually transmitted infections (STIs) are reported as a major health concern in the area. This is reportedly due to the polygamous nature of the community and prevailing high-risk sexual practices. There was little evidence on the actual prevalence of HIV or other STIs in the study area but these were by all accounts on the increase. Misconceptions related to transmission of STIs were reported and as a result, unsafe sexual practices were reported with condom use reported as low. Stigma and potential for discrimination was thus high.

Reproductive health services are limited and HIV counselling and testing, care and treatment is not available in the study area. As patients need to travel to Kolwezi for these services there is limited knowledge of individual HIV status in the area. As a result, there is limited data on STIs and HIV/AIDS in the study area. In addition, there is minimal institutional capacity to support outreach HIV and STI services locally.

Social ills, such as substance abuse and transactional sex have reportedly increased in the makeshift settlements around Mukanga and Katayi. Project workers are reportedly the main targets and clients in transactional sexual relationship as they have disposal income. Young girls are noted to be extremely vulnerable to advances from men.

To combat this Kamoa will:

- Plan knowledge, awareness and practices surveys on HIV in the licence area to support education and communication programmes. This is part of promoting behaviour change and reducing the risk of HIV and STI transmission;
- Evaluate the potential of establishing a surveillance system to support longitudinal monitoring of STIs and HIV. This may require using antenatal care services as an important data source to support this system and to roll out prevention of mother to child transmission in the licence area;
- Develop a clear HIV policy and program in the workplace and community;
- Develop specific HIV/AIDS educational campaigns for contractors (particularly transport workers, drilling workers and the migrant construction workforce as high-risk groups);
- Initiate early elements of an HIV awareness and prevention programme at the workplace and expand to the broader community. These will include awareness programmes targeted at behaviour change, access to and social marketing of condoms and access to appropriate health care services;
- Link care and treatment initiatives should be evaluated in partnership with the national programme; and
- Evaluate opportunities as part of the community development plan to promote empowerment programmes for women.

Tuberculosis

Tuberculosis (TB) is a major national concern and local level health concern, and is often associated with HIV/AIDS infection. The health services in the study area are poor and case detection and effective treatment of TB is inadequate. This coupled with the limited access and poor health seeking behaviour poses a risk that TB transmission may increase the study area if a more conducive environment is created.

There is a risk that conditions such as pneumonia and measles can increase linked to influx as their transmission is influenced by poor socio-economic and living conditions as well as general poor state of health.

To combat this Kamoa will:

- Adequate fitness to work programs and pre-deployment screening to reduce potential communicable disease transmission; and
- Evaluate opportunities for Health systems strengthening (HSS) to improve the ability to recognise and manage TB in the area and improve coverage of essential vaccines in children under 1 year of age.

The Chief Medical Officer (CMO) will keep a record of employee medical examinations, specific surveillance records and medical history. Education programs will be rolled out at the mine site and in the surrounding population centres.

12.2 Emergency measures

Kamoa are currently in the process of developing a specific emergency preparedness and response plan. The plan will contain the following information:

- Identified areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected Communities and periodic training to ensure effective response;
- Provisions for assisting and collaborating with the potentially Affected Communities and the local government agencies in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to ensure effective response;

- Emergency preparedness and response activities, resources, and responsibilities, and mechanisms to provide information to potentially Affected Community and relevant government agencies; and
- For both workers and communities it will provide details on:
  - Specific emergency response procedures;
  - Trained emergency response teams;
  - Emergency contacts and communication systems/protocols (including communication with Affected Communities when necessary);
  - Procedures for interaction with government authorities (emergency, health, environmental authorities);
  - Permanently stationed emergency equipment and facilities (e.g., first aid stations, firefighting equipment, spill response equipment, personal protection equipment for the emergency response teams);
  - Protocols for the use of the emergency equipment and facilities;
  - Identification of evacuation routes and muster points;
  - Emergency drills and their periodicity based on assigned emergency levels or tiers; and
  - Decontamination procedures and means to proceed with urgent remedial measures to contain, limit and reduce pollution within the physical boundaries of the project property and assets to the extent possible.

12.2.1 Emergency measures for TSF Breach

A study by EPOCH (EPOCH, 2016) included a preliminary evaluation of the potential extent of TSF failure. Their findings indicated that:

- The preferred TSF site is located between two ridges, one of which is upstream of the proposed plant area and possible future location of the accommodation camp;
- Two sets of model runs were undertaken (flows were exaggerated in order to determine the worst case scenario and a conservative mitigating solution):
  - The first set or model runs were used to identify the possible flow paths that could be produced from a breach at any point along the impoundment wall. Flow surfaces were modelled at angles ranging from 2% to 4% which has been documented from past failures; and
  - The second set of model runs were used to determine the extent of tailings flow from a critical (full) breach.
- It may be possible that a flow slide could affect the camp downstream of the TSF, however more detailed assessment is required to determine the extent of the actual flow considering the topography of the site; and
- An 8 m high berm provided just outside the fence could provide the camp the necessary protection from a flow slide.

Additional emergency measures are being developed by Kamoa specific for any tailings breach includes:

- Installing breach monitoring systems;
- Ensuring that any sufficient emergency equipment would be able to mobilise to contain any breach; and
- Ensuring that downstream receptors are made aware of emergency protocols in the event of a breach (e.g. safe zones, emergency alerts and emergency roues).

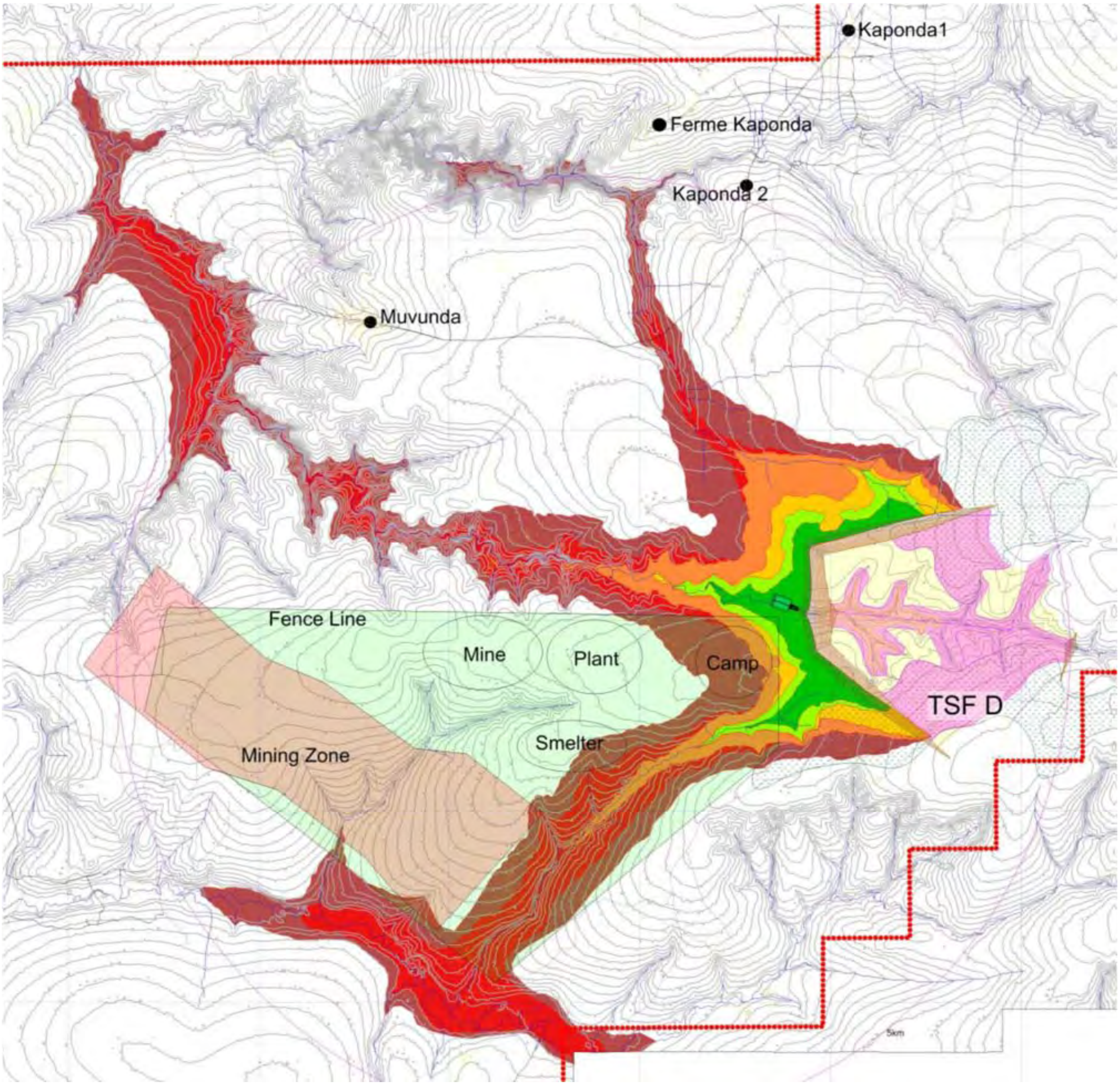


Figure 79: Possible tailings flow slide from a breach at any point along the impoundment wall

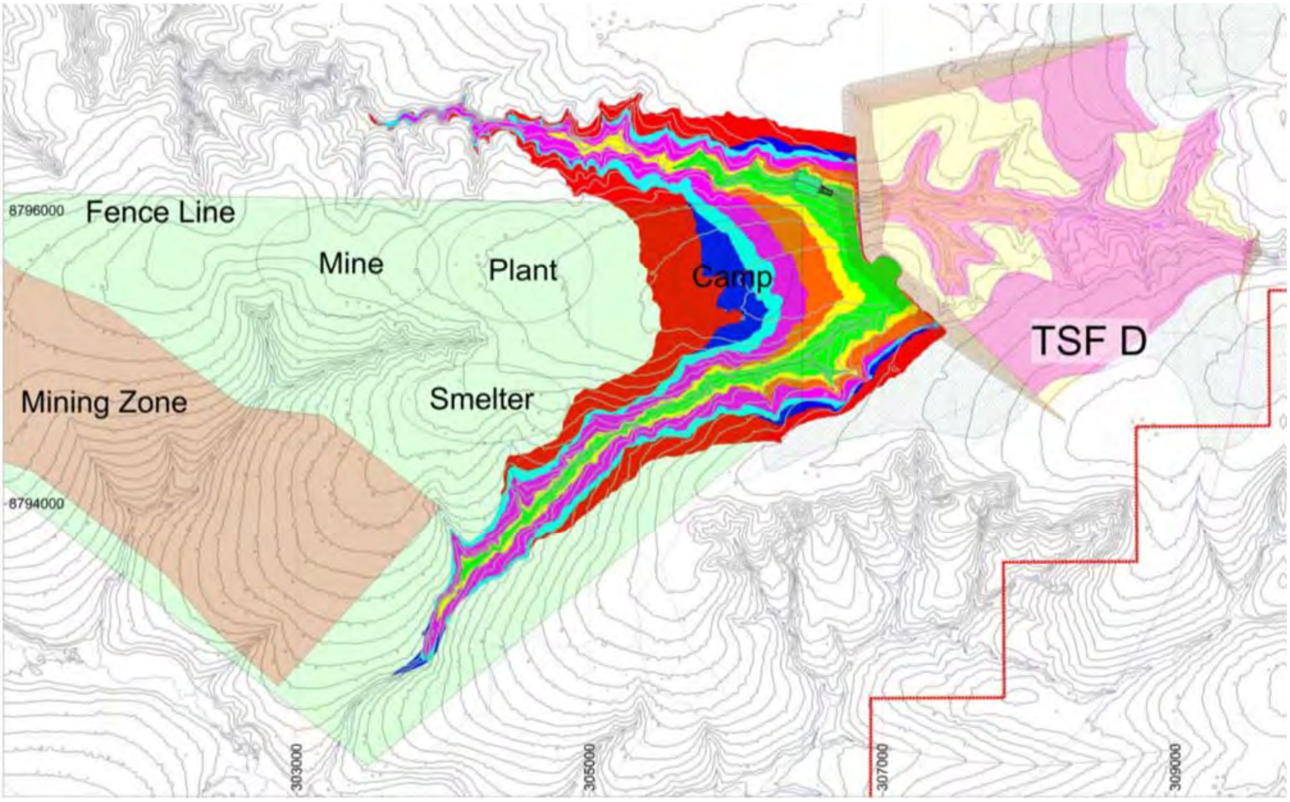


Figure 80: Tailings Flow Slide originating from a Critical breach (worst case scenario)

13.0 CHAPTER VII: ATTENUATION AND REHABILITATION MEASURES AFTER SITE CLOSUREREHABILITATION AND CLOSURE

The Democratic Republic of Congo legislation governing rehabilitation and closure is contained in Mining Decree no. 038/2003 of 26 March 2003 (Annexure IX – Articles 95-125), which describes the legal requirements for rehabilitation and closure.

The below sections provide the DRC legislative requirements governing rehabilitation and closure as well as the rehabilitation and closure measures to be implemented at closure to meet these requirements.

13.1 Description of attenuation and rehabilitation measures on site closure

Article 95 require a mining site to be stable, limited residual adverse environmental effects, doesn't pose a health and safety threat and is amenable to the next land use that is acceptable to the community.

To meet these requirements the following performance objectives related to rehabilitation and closure have been set:

- **Physical stability:** to remove and/or stabilise surface infrastructure, unavoidable mining residues that are present on the mine to facilitate the implementation of the planned land use;
- **Environmental quality:** to ensure that local environmental quality is not adversely affected by possible physical effects and chemical contamination arising from the mine site;
- **Health and safety:** to limit the possible health and safety threats to humans and animals using the rehabilitated mine site as it becomes available;
- **Land capability/land-use:** to re-instate suitable land capabilities over the various portions of the mine site to facilitated the progressive implementation of the planned post mining land use;

- **Aesthetic quality:** to leave behind a rehabilitated mine site that, in general, is not only neat and tidy, giving an acceptable overall aesthetic appearance, but which in terms of this attribute is also aligned to the respective land uses;
- **Landscape viability:** to create a landscape that is self-sustaining and over time will converge to the desired ecosystem structure, function and composition;
- **Biodiversity:** to encourage, where appropriate, the re-establishment of native vegetation on the rehabilitated mine sites such that the terrestrial biodiversity is largely re-instated over time; and
- **Social:** to ensure that the infrastructure transfers, measures and/or contributions made by the mine towards the long-term socio-economic benefit of the local communities are sustainable.

13.2 Revegetation

All areas affected by the project will be re-vegetated using local plant species. The following revegetation measures will be implemented over the disturbed site:

- Prepare surface rehabilitation areas for the natural establishment of vegetation by undertaking the following:
  - Rip disturbed footprint to a depth of approximately 500 mm with suitable agricultural equipment to alleviate compaction;
  - For areas that are heavily compacted (hard stands, haul roads), rip with construction equipment to a depth of at least 1 m, and over-rip with agricultural equipment in order to create suitable conditions for vegetation establishment; and
  - Ameliorate soils as required.
- Allow for natural establishment of a viable self-sustaining vegetation community, in keeping with the surrounding natural environment, or establish pioneer vegetation species as per findings of dedicated rehabilitation trials; and
- Undertake vegetation monitoring post closure to ensure rehabilitation success.

The final objectives and compliance criteria for closure relating to infrastructure are reflected in Table 76.

Table 76: Revegetation – Closure Objectives and Compliance Criteria

Objective	Preliminary completion criteria
Mining lease does not house any exotic weed species that are not ubiquitous to the region	Exotic weed species are not observed to be elevated in abundance when compare to the regional setting as reported by a trained independent botanist.
Revegetated areas house native species with landscape functional indices trending towards surrounding areas	Monitoring sites are established on site (1 per 50 ha of rehabilitation) and surrounding sites (at least four representative control sites). Flora species diversity in rehabilitated areas are representative of control sites. Foliage density of monitoring sites are at least 80% when compared to the average of the control sites.

13.3 Contaminated soils

The aim of the attenuation and rehabilitation measures after site closure is to ensure that contaminated land is not harmful to health and the environment and that it is compatible with its future use.

Practical achievement of this objective is part of a process that aims at the rehabilitation of soils contaminated by mining or quarrying activities, with the exclusion of mine waste storage areas and authorized waste elimination locations.

13.3.1 Action relating to contamination exceeding criterion B

Kamoa will carry out the following actions where the measured level of contamination exceeds criterion B as per the DRC Mining Code, for any parameter that has been distinguished from the local natural background levels.

Depending on the levels of contamination the following actions will be undertaken:

- Level < A – Uncontaminated environment; no corrective action;
- Range A-B – Slightly contaminated environment; no action except if there is impact on the underground water quality;
- Range B-C – Contaminated environment:
  - in-depth analysis will be undertaken;
  - decontamination work may be needed to achieve the objectives when a piece of land is being rehabilitated, in particular where it is to be used for residential purposes; and
  - if industrial uses are envisaged, there may be no need to carry out decontamination.
- Level > C – highly contaminated environment:
  - exhaustive characterization will be undertaken; and
  - mitigation work will be undertaken when activities cease unless the objective of rehabilitation is demonstrated whatever the future planned use of the land.

13.3.2 Attenuation and rehabilitation work on contaminated soil

The following will be undertaken at closure to ensure that contaminated soils are identified and rehabilitated/ removed:

- Undertake a site-wide contaminated soil/land assessment to determine the nature and extent of contamination, the sources of contamination and to identify appropriate remediation measures;
- Rehabilitate contaminated soils classified as level B-C contamination, as per Mining Decree no. 038/2003 of 26 March 2003 (Annexure IX) as follows:
  - Inorganic contamination:
    - Excavate contaminated material to a depth of 300 mm and remove and dispose of at an elimination site as authorised by the Department responsible for Protection of the Mining Environment. In the case that this is not feasible, a hazardous waste facility will be constructed at KCP and dangerous waste disposed of as follows:
      - Dispose hazardous waste into the lined waste cells as per the company's safe operating procedures for handling of hazardous waste;
      - Shape the in-filled surface to facilitate the drainage of rainfall;
      - Cap the hazardous waste cell with an impermeable cover protected by geo-cells; and
      - Establish vegetation within the geo-cells.
  - Organic contamination:
    - Treat organic contamination by means of biological remediation via the establishment of a bio-remediation site.

13.4 Measures relating to buildings, infrastructure and surface equipment

The following measures relating to buildings, infrastructure and surface equipment will be implemented at closure:

Infrastructure for potential beneficial re-use:

- Compile an inventory of infrastructure and equipment to potentially remain at closure, aligning to end land use plan;
- Obtain legal authorisations for infrastructure to remain and to be transferred; and
- Finalise agreements with third parties, along with transfer schedule and responsibilities.

Surface infrastructure to be removed:

- Remove all assets/equipment that can be profitably removed for salvage or resale;
- Dismantle/demolish infrastructure;
- Decontaminate at the dedicated decontamination bay constructed during operations;
- Demolish and excavate concrete foundations to 1 m below ground level. Alternatively and in appropriate instances the concrete slabs of “clean” infrastructure (not processing infrastructure) can be covered with a 1 000 mm soil cover as part of site re-profiling and integrated into the surrounding topography;
- Backfill excavations of disturbed infrastructure footprint areas through a cut to fill action;
- Shape and profile the disturbed surface areas to match surrounding topography and to ensure free drainage, thus limiting run-off erosion;
- Stabilise disturbed areas to prevent erosion and sediment mobilisation in the short to medium term until a suitable vegetation cover has been established;
- Rip disturbed footprint to a depth of approximately 500 mm with suitable agricultural equipment to alleviate compaction; and
- Establish vegetation species that mimic the surrounding Miombo woodland by collecting seed from pristine woodland and actively planting before the wet season.

13.4.1 Measures relating to the pit head, service buildings and processing plant buildings

The same requirements as those mentioned above for administration buildings will apply to pit heads and service buildings and processing plant buildings.

Kamoa will assess the quality of the underlying soil at closure as indicated in section 13.3 and, if need be, carry out decontamination.

13.4.2 Measures relating to support infrastructure

Support infrastructure including pipelines will be decommissioned as follows:

- Flush pipelines that could contain contaminants/sludge with water to remove any residual solution and/or contaminated sediments and dispose of onto the TSF;
- Compile an inventory of pipelines to potentially remain at closure for transfer to third party;
- Obtain legal authorisations for infrastructure to remain and to be transferred;
- Finalise agreements with third parties, along with transfer schedule and responsibilities;

- In addition Identify and donate equipment to local communities that can be reused and/or recycled that is not salvaged by the mine;
- Dismantle the remaining overland pipelines and salvage as possible and/or locate at predetermined area for off-site removal; and
- Seal open ends of buried pipelines and fully cover with nothing exposed.

13.4.3 Measures required for transport infrastructure

Agreements will be put in place between KCP and local communities as well as the relevant authorities for roads to remain post closure for beneficial use by the local communities.

Roads that will no longer be used by local communities post closure will be rehabilitated as follows:

- Re-establish natural drainage, including the removal of culverts and/or trenching;
- Profile to be free draining and emulating the natural surface topography;
- Rip access roads to a depth of approximately 300 mm with suitable agricultural equipment to alleviate compaction; and
- Establish vegetation species that mimic the surrounding Miombo woodland by collecting seeds from pristine woodland and actively planting before the wet season.

13.4.4 Measures relating to electrical equipment and infrastructure

Legal authorisations will be obtained for electrical equipment to remain and/or be transferred. This equipment will be identified and donated to local communities. Electrical equipment that is not transferred will be dismantled and removed as follows:

Power lines:

- Compile an inventory of power lines to potentially remain at closure for transfer to third party;
- Obtain legal authorisations for infrastructure to remain and to be transferred;
- Finalise agreements with third parties, along with transfer schedule and responsibilities;
- In addition Identify and donate equipment to local communities that can be reused and/or recycled that is not salvaged by the mine; and
- Dismantle the remaining power lines and salvage as possible and/or locate at predetermined area for off-site removal.

Electrical equipment:

- Dismantle and remove substations no longer required at closure;
- Remove generators offsite and demolish concrete bases;
- Dispose of demolition waste at demolition waste site;
- Clean up contaminated soils at the generator site, as required, as per section 13.2.

The final objectives and compliance criteria for closure relating to infrastructure are reflected in Table 77.

Table 77: Infrastructure – Closure Objectives and Compliance Criteria

Objective	Preliminary completion criteria
Decommission or gain agreement for the transfer of liability of all mine infrastructure	Formal transfer of ownership and liability of specific infrastructure. Independent sign-off by a qualified engineer confirming the safe and stable condition of all transferred infrastructure. All other infrastructure decommissioned to ground level and removed from site.

13.4.5 Measures relating to surface equipment and heavy machine

Surface equipment and heavy machinery will be decommissioned and rehabilitated as follows:

Conveyors:

- Dismantle steel structures and demolish concrete footings; and
- Dispose demolition waste at demolition waste site.

Ore processing equipment:

- Dismantle/demolish ore processing equipment;
- Decontaminate ore processing equipment at the dedicated decontamination bay constructed during operations;
- Demolish and excavate concrete foundations to 1 m below ground level. Alternatively and in appropriate instances the concrete slabs of "clean" infrastructure (not processing infrastructure) can be covered with a 1 000 mm soil cover as part of site re-profiling and integrated into the surrounding topography;
- Clean up contaminated soils as per section13.3; and
- Undertake general surface rehabilitation as per section 13.2.

Machinery and vehicles:

- Identify equipment that can be reused and/or recycled that will not be salvaged;
- Remove remaining equipment offsite for sale or disposal at a registered waste site; and
- Clean-up contaminated soils as per section 13.3.

13.5 Measures relating to underground equipment, heavy machinery and infrastructure

Underground equipment will be brought to surface and decommissioned as outlined in section 13.4.5 above. All underground equipment will be decontaminated and contaminated materials disposed of as per section 13.3.

SECTION III: MEASURES RELATING TO UNDERGROUND AND OPEN-AIR WORK

13.6 Measures relating to excavations and areas of stripping

Excavation areas remaining after the removal of surface infrastructure will be rehabilitated as follows:

- Shape and profile footprint areas to be free draining; and
- Rip areas to alleviate compaction and establish vegetation.

The final objectives and compliance criteria for closure relating to landforms are reflected in Table 78.

Table 78: Landforms – Closure Objectives and Compliance Criteria

Objective	Preliminary completion criteria
All landforms will be inherently safe and stable over the long term	Slope angles will not exceed 20 degrees slope. No gullies greater than 30 cm in depth are evident on the surface of landforms at the conclusion of the first wet-season post closure.

13.6.1 Excavations and open ditches

Not applicable at this stage as no opencast mining is proposed to take place at Kamoa.

13.7 Safety of above-ground openings

Above ground openings and shafts at surface will be decommissioned as follows:

- Dismantle and remove ventilation fans and associated equipment/structures;
- Plug and seal incline and ventilation shafts;
- In-fill box cut area using available/stockpiled overburden material;
- Place topsoil over the backfilled area;
- Shape footprint area to be free-draining (aligned to site-wide routing);
- Rip area to alleviate compaction; and
- Establish vegetation.

13.7.1 Measures relating to the stability of shafts at the surface

As per section 13.7.

13.8 Measures relating to pumping water ponds

Ponds, dams and impoundments:

- Remove sediments to a depth of approximately 200 mm;
- Removal HDPE synthetic liner, if required;
- Load and haul contaminated soil/sludge and HDPE liner systems and dispose of at the TSF;
- Undertake surface profiling to ensure that the area is free draining;
- Rip the area to a depth of approximately 500 mm to alleviate compaction; and
- Undertake general surface rehabilitation as per section 13.2.

13.9 Measures relating to mine waste

Mine waste dumps (waste rock dumps) will be rehabilitated so that they are aesthetically pleasing and blend in with the surrounding environment as far as possible. The following measures will be implemented at closure:

- Retain the dump slopes at the originally constructed angle of repose with long uniform slopes;
- Place topsoil over the waste rock dumps to limit infiltration into the WRD and possible seepage of contaminated water into the groundwater system;
- Infill areas of erosion along the side slopes of the waste rock dump and vegetate;

- Construct toe paddocks along the toe of the facility, where the accumulation of sediment as a result of erosion is likely to impact on the surrounding environment;
- Conduct cursory improvement of upper surfaces to limit excessive ponding; and
- Allow natural vegetation to establish and maintain as far as possible.

13.9.1 Measures relating to physical stability

The measures described in Annex XIV of the Mining Regulations will be strictly adhered to by KCP in addition to the measures described above (section 13.9).

13.9.2 Measures relating to wastes that generate acidic mining drainage

As indicated in section 3.11, Kamoa anticipate that there will be approximately 60,000 tonnes of KPS and upper Diamictite waste generated from the Kansoko mine and likely a similar amount from Kakula. Provisions have been made for the containment of these waste during operations, however there is a possibility that this waste could be utilised for other purpose. Should full closure of the KPS waste rock dumps be required the closure plan will be updated to include measures for areas that could potentially be acid generating, to mitigate the production of the drainage as well as mitigate potential environmental impacts.

13.9.3 Measures relating to the mine waste depot and sedimentation ponds

The following rehabilitation measures will be implemented over the long-term waste facilities to ensure that they are stable and are not a source of dust and/or contaminated runoff:

Tailings storage facilities:

- Plug and seal penstock and remove infrastructure;
- Utilise beach to route surface water from upper surface and undertake shaping where required;
- Create cross walls along the upper surface of the TSF to limit dust erosion; and
- Establish vegetation.

13.9.4 Measures relating to the physical stability of confinement structures

Even if no more mine waste is being added into the waste rock dumps or tailings, Kamoa will ensure that the confinement structures remain stable.

13.9.5 Measures relating to the chemical stability of materials

The seepage associated with the tailings facility and the WRD will need to be sampled and analysed. Once more information becomes available, this will be reassessed and closure measures will be determined as necessary.

13.9.6 Measures relating to water collection structures

Facilities will be decommissioned and dismantled at closure as per section 13.8.

13.10 Measures relating to Mine Waste

Surface and groundwater monitoring will continue to be undertaken post closure to ensure that mining effluents meet the regulatory requirements. Monitoring should be undertaken as per Table 79 below.

Table 79: Surface and groundwater monitoring

Component	Measures
Surface water	■ Monthly monitoring of surface water sites for quality – for at least 5 years post-closure or until site relinquishment criteria have been achieved; and ■ Conduct biomonitoring at selected downstream sites for at least 5 years or until site relinquishment criteria have been achieved.
Groundwater	■ Quarterly monitoring of boreholes (water quality and level) – for at least 5 years post-closure or until site relinquishment criteria have been achieved.

The final objectives and compliance criteria for closure related to water are reflected in Table 80.

Table 80: Water – Closure Objectives and Compliance Criteria

Objective	Preliminary completion criteria
Surface water resources discharging from the mine lease are consistently of similar quality to the surrounding water sources	Water samples taken from sampling points downstream of the mine are within DRC effluent quality guidelines for a 12 month period.
Groundwater flows do not adversely affect downstream users or environmental ecosystems	Water samples taken from representative groundwater monitoring boreholes mine are within DRC effluent quality guidelines for a 12 month period.

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13.11 Measures relating to sanitation installations

Water and sewage treatment facilities will be decommissioned and dismantled at closure as per section 13.4 and section 13.8.

13.12 Measures relating to petroleum products

The following measures will be implemented at closure:

- Remove oil drums and petroleum products off site for re-sale/use;
- Demolish the storage area and associated tanks in which petroleum products are stored;
- Decontaminate at the dedicated decontamination bay constructed during operations;
- Demolish and excavate concrete foundations to 1 m below ground level; and
- Clean up contaminated waste as per section 13.3.

13.13 Measures relating to dangerous waste

All dangerous waste as identified during the contaminated land assessment (section 13.3) will be transported to an elimination site as authorised by the Department responsible for Protection of the Mining Environment. In the case that this is not feasible, a hazardous waste facility will be constructed at KCP and dangerous waste disposed of as follows:

- Dispose hazardous waste into the lined waste cells as per the company's safe operating procedures for handling of hazardous waste;
- Shape the in-filled surface to facilitate the drainage of rainfall;
- Cap the hazardous waste cell with an impermeable cover protected by geo-cells; and
- Establish vegetation within the geo-cells.

13.14 Measures relating to solid waste

Solid waste, which meets the standards for contamination as per section 13.3, will be disposed as follows:

- Sort and screen waste produced from the dismantling and demolition of infrastructure;
- Crush decontaminated concrete, if required, to reduce uptake in waste cells;
- Recycle waste that can be recycled/salvaged (e.g. steel) after decontamination; and
- Dispose of inert demolition waste in a waste disposal facility authorised by the Department responsible for Environmental Protection and cap/close per approved designs.

TITLE VI: THE DETAILED BUDGET AND FINANCING PLAN OF PROGRAM OF MITIGATION AND REHABILITATION MEASURES AND OF FINANCIAL GUARANTEE OF ENVIRONMENTAL REHABILITATION

14.0 BUDGET FOR THE SITE MITIGATION AND REHABILITATION PROGRAM

14.1 Financial Security for the Rehabilitation of the Environment

Any person performing research or mining or quarrying operations is required to assess the total cost of environmental mitigation and rehabilitation measures to reduce the impact of their operations and to provide for the establishment of a " A financial security", the form and manner of payment of which are different, as the case may be.

14.2 Description of the financial guarantee

As part of this rehabilitation and closure guidance report, the closure costs were determined for KCP at the end of Life of Mine (scheduled closure). As KCP is currently updating the mining plan, limited information is available to inform the determination of these costs. The costs provided are therefore as per the approved financial guarantee as per the EIS in 2012.

The schedule of payments as per Annexure II is presented in Table 81.

Table 81: Financial Guarantee Payment Tranches

Année	Versement (USD)
2013	-
2014	30.821,00
2015	91.360,00
2016	153.000,00
2017	213.540,00
2018	275.180,00
2019	336.820,60
2020	-

Budget relating to the site attenuation and rehabilitation program and has been previously agreed between Kamoa and DPEM.

14.3 Budget relating to the site attenuation and rehabilitation program

The detailed budget for the program for the proposed attenuation and rehabilitation measures listed in section 9.0 is presented in Table 82. The information presented in will be Table 82 updated every six months. Post closure monitoring is presented in section 14.2 below.

Financing of this budget is included in annual financial planning and the financial guarantee presented below will provide the financing for rehabilitation works should Kamoa be unable to carry out the attenuation and rehabilitation measures.

Table 82: Budget for the Implementation of Attenuation and Rehabilitation Measures Contained in section 9.0

Mitigation Measure	Labour requirements (See Figure 76 for organisational structure) per annum	Overheads per annum	Other Expenses (once Off)	Estimated costs per year	Duration of Activities (years)
Overall Implementation of EMPP	$534 000.00	$26 700.00		$560 700.00	>15 years
Radiation Monitoring			$5 000.00	$0.00	>15
Revegetation nursery, concurrent rehabilitation and ecological Monitoring		$100 000.00		$100 000.00	>15
Resettlement			$750 000.00	$0.00	1
Phase 2 archaeological investigations during construction			$20 000.00	$0.00	1
Noise Monitoring		$1 000.00		$1 000.00	>15
Vibration Monitoring		$1 000.00	$20 000.00	$1 000.00	>15
Water Quality Monitoring		$60 000.00		$60 000.00	>15
Air Quality Monitoring		$10 000.00	$50 000.00	$10 000.00	>15
Public Consultation		$12 000.00		$12 000.00	>15
TOTAL	**$534 000.00**	**$210 700.00**	**$845 000.00**	**$744 700.00**	

The implementation of the first phase of the program targeted vulnerable households who were outside and inside the mine foot print whose poverty level was above 80%.

Community economic development

The community economic development program involves projects such as infrastructure building and rehabilitation. Most of these projects are orientated into health and education. For details see Table 85: SSDP Community Economic Development.

Community skill transfer

Skills transfer has been undertaken through the livelihoods program targeting women to be enabled to undertake various income generating activities (sewing program, chicken breeding, etc). For details see Table 86: SSDP Community and Staff Skills Transfer.

SDP Update

A community needs assessment was undertaken by Kamoa in 2014 within communities that will potentially be affected by its operations. The needs assessment provided indications on the most important concerns for these communities and their priorities. Community projects were then proposed based on the results of the need assessment exercise.

In 2015, the Lufupa and the Luilu sectors where the Kamoa Copper SA is carrying out its operations developed their own Local development Plan with the assistance of local NGO (SADRI and Alternative Plus) financed respectively by Cordaid and GIZ.

From the recommendations made by Investissement Durable au Katanga (IDAK), Kamoa engaged the Lufupa sector and set up a workshop to align its SDP to the Lufupa LDP. The workshop took place from 10th to12th March 2016 at Musokantanda and involved community leaders, Government representatives, two mining companies (Kamoa Copper SA and Kalongo Mining) and two NGOs (SADRI and ACIDH). Based on outcomes of this workshop the SSDP has been updated to align with the key objectives and strategies of the Lufupa LDP. Further updates will be undertaken once the Lufira sector LDP has been fully developed.

Table 83: SSDP - Stakeholder Engagement

ITEM NO	PROGRAM/ACTIVITY	OBJECTIVE	TARGET	TARGET COMMUNITY	ANTICIPATED OUTPUT	IMPLEMENTATION YEAR				
						2016	2017	2018	2019	2020
1	**COMMUNITY MEETINGS**									
	Community leaders meetings (chiefs, headmen, CDC…)	- Ensure communities are aware of KAMOA SA activities and operation progress - Record community views and concerns and any grievances	33 CDC 2 chiefs of land 2 grouping chiefdoms 2 chiefs of sector	Musokantanda and Mwilu grouping chiefdoms	-Communities from the 2 chiefdoms are well informed on KAMOA SA activities - Community concerns are recorded by the company and taken into consideration					
	Meetings with Government officials (AT, Mayor, Provincial government, Governor)	- Ensure government officials are aware of KAMOA SA activities and operation progress - Record government officials views and concerns	Administrator of Mutshatsha Mayor of Kolwezi Provincial ministers of Mines, Environment, Planning, Agriculture, Health, Education Governor of Lualaba	Kolwezi and Mutshatsha	- Government officials are well informed about KAMOA SA - Their concerns are recorded by the company and taken into consideration					
	Community reviews	Review annually the community project achievements against the expected results and adjust plan for future	Lufupa and Luilu leaders, traditional chiefs, NGO partners,	Musokantanda and Mwilu grouping chiefdoms	-Projects planned for the year are reviewed and evaluated against the expected results. - Next year plan adjusted accordingly					
	Community visit and awareness	To ensure local community is informed on specific points from the company	Local community	Community living within the KAMOA SA footprint	Community living within the KAMOA SA footprint are kept informed of specific activities and initiatives from the company					
	Grievance management meetings	Evaluate and manage grievances that have been lodged by local community	Local community	Local community	All grievances that have been lodged are managed as per the grievance mechanism on place.					
	Official ceremonies	Show company interest and respect of official ceremonies including traditional	Government, local community	Government, local community	Company represented at official ceremonies					
2	**COMMUNITY CAPACITY BUILDING**									
	CDC training	Skills transfer	CDC	CDC members	CDC members provided with skills to act as community development actors					
	Community boards maintenance	Get community informed and aware of KAMOA SA operations, needs, offers…	Local community	Local community	Local communities are aware of KAMOA SA operations, needs, offers…					
3	**CSR WORKSHOP**									
	IDAK, Chamber of Mines, Company	Improve CSR	KAMOA SA	KAMOA SA	KAMOA SA improves and shares knowledge about CSR					

Table 84: Sustainable Development Plan

ITEM NO	PROGRAM/ACTIVITY	OBJECTIVE	TARGET	TARGET COMMUNITY	ANTICIPATED OUTPUT	IMPLEMENTATION YEAR				
						2026-2017	2017-2018	2018-2019	2019-2020	2019-2021
1	**SMALL HOLDER MAIZE PROGRAM**									
	Sensitization, Creation and registration of co-operatives through local Development ministry	To empower local communities to enjoy benefits of being a legal entity and have access to credit facilities	6 cooperatives in 19 communities	Musokantanda Mulemena	2 villages sensitized, constitution developed, registered and become operational					
				Kamisange, Kavuma Cite Ma Kamoa Samukoko	4 villages sensitized, constitution developed, registered and become operational					
				Muvunda Kaponda	2 villages sensitized, constitution developed, registered and become operational					
				Katayi, Israel, Mundjendje	3 villages sensitized, constitution developed, registered and become operational					
				Mupenda, Kakunta, Kangaso	3 villages sensitized, constitution developed, registered and become operational					
				Tchiwisa Benkeni Djosayi Mukanga, Mawawa	5 villages sensitized, constitution developed, registered and become operational					
		Contribute to the improvement of food security in Lualaba province of the Democratic Republic of the Congo	2 communities	Mulemena "Musokantanda"	50 hectares cultivated					
			3 communities	Kamisange, Kavuma, Cite Ma Kamoa, Samukoko	20 hectares cultivated					
	Cultivation and planting of community maize ,beans and Winter thorn trees for nitrogen retention in the soils	To encourage farmers to practice conservation farming in order to maintain soil fertility and reduce on fertilizer costs	2 communities	Muvunda, Kaponda	20 hectares of maize cultivated per year					
			3 communities	Katayi, Israel Mundjendje	40 hectares of maize cultivated					
			3 communities	Mupenda, Kakunta Kangaso	20 hectares of maize cultivated					
			5 communities	Tchiwisa, Benkeni Djosayi, Mukanga Mawawa	150 hectares of maize cultivated					
	Training farmers in maize production, management and marketing	To transfer improved technology in maize production in order to increase	19 communities	Musokantanda, Mulemena Kamisange, Kavuma, Cite Ma Kamoa, Samukoko, Muvunda, Kaponda Katayi, Israel, Mundjendje, Mupenda, Kakunta, Kangaso Tchiwisa, Benkeni Djosayi, Mukanga Mawawa	500 farmers trained in improved agriculture farming practices.					

	Establishment of a maize milling plant to service cooperatives and Kamoa	To create self-reliance in co-operatives, add value to the product by selling a finished product	1 high grade milling plant	Musokantanda, Mulemena Kamisange, Kavuma, Cite Ma Kamoa, Samukoko, Muvunda, Kaponda Katayi, Israel Mundjendje, Mupenda Kakunta, Kangaso Tchiwisa, Benkeni Djosayi, Mukanga Mawawa	19 communities belonging to the co-operative, Improved food security to at least three thousand beneficiaries, Reliable supply and Cost reduction on mealy meal for Kamoa					
	Construction of maize satellite depots for storage of maize	Increased shell life of maize in order to avoid wastage	1 satellite depot for maize storage	Mulemena "Musokantanda"	1 satellite depot constructed for improved storage of maize					
			1 satellite depot for maize storage	Kamisange, Kavuma, Cite Ma Kamoa, Samukoko	1 satellite depot constructed for improved storage of maize					
			1 satellite depot for maize storage	Muvunda Kaponda	1 satellite depot constructed for improved storage of maize					
			1 satellite depot for maize storage	Katayi, Israel Mundjendje	1 satellite depot constructed for improved storage of maize					
			1 satellite depot	Mupenda, Kakunta Kangaso	1 satellite depot constructed for improved storage of maize					
			1 satellite depot	Tchiwisa, Benkeni Djosayi, Mukanga Mawawa	1 satellite depot constructed for improved storage of maize					
2	**COMMUNITY VEGETABLE PRODUCTION**									
	Facilitate the creation of vegetable cooperatives, constitution development and registration	Improve service delivery and self-reliance	1 cooperative	Katayi, Kakunta Mupenda	One cooperative established and functional					
			1 cooperative	Tshiwisa, Mawawa Benkeni, Mukanga	One cooperative established and functional					
			1 cooperative	Kaponda, Israel Muvunda	One cooperative established and functional					
	Support to communities in vegetable seedlings production by use of improved agriculture equipment like vegetable tunnel systems	Increase productivity and income levels through improved vegetable production in a green and clean environment	2 communities	Katayi, Kakunta Mupenda	15000kg of vegetables produced per month					
			4 Communities	Tshiwisa, Mawawa, Benkeni, Mukanga	1500kgs of vegetables produced per month					
			3 communities	Kaponda, Israel Muvunda	4000 kgs of vegetables produced per month					
	Training communities in modern vegetable production ,management and marketing		10 communities	Katayi, Kakunta Mupenda, Tshiwisa Mawawa, Benkeni Mukanga, Kaponda Israel, Muvunda	200 community members trained and become competent in vegetable production and management					
	Evaluation of vegetable program		10 communities	Katayi, Kakunta Mupenda, Tshiwisa Mawawa, Benkeni Mukanga, Kaponda	Information gathered on vegetable project results and economic impact as a result of Kamoa's intervention					

				Israel, Muvunda						
3	**POULTRY PRODUCTION AND MANAGEMENT**									
	Facilitate the creation of cooperative for women involved in poultry	To create self-reliance and improve productivity	One cooperative	Katayi Mundjendje Kaponda Israel	One reliable co-operative created for continuous supply of chickens to Kamoa and Communities					
	Construction of two poultry houses for Israel and Kaponda women	Increase production of broiler meat and eggs	Two poultry houses	Kaponda Israel	25,200 chickens produced per year managed by one cooperative					
	Training in Production , management and marketing of Broiler chicken for communities	Improve poultry management skills in women groups	100 women	Katayi Mundjendje Kaponda Israel	25,200 chickens sold by four women groups trained in management and marketing of broilers					
	Production and management of layers	Improve poultry management skills in women groups	800 layers	Katayi Mundjendje Kaponda Israel	200,000 eggs sold by four women groups belonging to one cooperative					
				Kaponda Israel						
	Evaluation of Poultry program	To assess the performance of the poultry program	Six communities belonging to one cooperative	Katayi Mundjendje Kaponda Israel Kaponda	Information gathered on poultry project results and economic impact as a result of Kamoa's intervention					
4	**BEEKEEPING /HONEY PRODUCTION AND MANAGEMENT**									
	Creation of beekeeping/ honey production cooperative	To promote self-reliance and productivity	Four communities	Musokantanda, Kamisange Muvunda Kaponda	Four communities actively participating in sustainable beekeeping with improved					
			Two communities	Mawawa Mukanga	Two communities actively participating in sustainable beekeeping with improved					
	Training in improved and sustainable organic honey production ,processing , packaging , marketing and production of materials	Increase skills in sustainable beekeeping thus	6 communities	Musokantanda, Kamisange, Muvunda Kaponda, Mawawa, Mukanga	8 tons of honey produced					
	Evaluation of beekeeping and honey program				Information gathered on beekeeping/honey project results and economic impact as a result of Kamoa's intervention					
5	**SMEs (SMALL TO MEDIUM ENTERPRISES)**									
	Creation of SMEs in Mushroom production				To be confirmed					
	SME in carpentry, for furniture				To be confirmed					
	SME in Sunflower and peanut production for cooking oil and peanut butter				To be confirmed					

6	**SKILLS TRANSFER AND FARMER TRAINING FACILITIES**									
	Construction or rehabilitation of farmer training center	To inculcate agriculture skills to farmers in a formal way in order to improve food security.	1	All six cooperatives	Improved sustainable agriculture practices and increased yields					
	Strengthen partnerships with NGO having the same objectives as Kamoa Copper SA	To help in building social safety nets	2 NGOs	19 communities	Improved service delivery					

Table 85: SSDP Community Economic Development

ITEM NO	PROGRAM/ACTIVITY	OBJECTIVE	TARGET	TARGET COMMUNITY	ANTICIPATED OUTPUT	IMPLEMENTATION YEAR				
						2016	2017	2018	2019	2020
1	**COMMUNITY ASSETS AND INFRASTRUCTURES**									
	School construction and rehabilitation	- Improve local pupil access to education	Students from communities living in the mining footprint	Communities living in the mining footprint	- Schools are built within the mine footprint following the Government guidelines and policies - Students from communities living within the mine footprint have access to education					
	Provision of school equipment and furniture (desks, tables, books…)	- Improve local pupil education quality	Students from I communities living in the mining footprint	Communities living in the mining footprint	- Schools in the mine footprint are equipped following the Government guidelines and policies - Students from communities living in the mining footprint have access to better education quality					
	Health facilities construction and rehabilitation	- Improve local community access to healthcare	People from communities living in the mining footprint	Communities living in the mining footprint	- Health facilities are built within the mine footprint following the Government guidelines and policies - People from communities living in the mining footprint have access to better healthcare					
	Health facilities equipment	- Improve local community healthcare quality	People from communities living in the mining footprint	Communities I living in the mining footprint	- Health facilities within the mine footprint are equipped following government guidelines and policies - People from communities living in the mining footprint have access to better healthcare					
	Boreholes and water reticulations	- Improve local community access to potable water	People from communities living in the mining footprint	Communities living in the mining footprint	- Boreholes and water facilities are built within villages located into the mine footprint - People from communities living in the mining footprint have access to potable water					
	Recreational community center	- Provide to the community a recreational area for main ceremonies: meetings, library, entertainment…	People from communities living in the mining footprint	Communities living in the mining footprint	- Recreational community center set up.					

ITEM NO	PROGRAM/ACTIVITY	OBJECTIVE	TARGET	TARGET COMMUNITY	ANTICIPATED OUTPUT	IMPLEMENTATION YEAR				
						2016	2017	2018	2019	2020
	Bursary program	- Encourage pupils to do better at school - Encourage girls to attend school	Improved student performance	Communities living in the mining footprint	- Brilliant pupils are assisted for the fees and furniture's					
2	**ASSET MANGERS CAPACITY BUILDING**									
	Water committee training	Skill transfer	CDC or other committees	CDC members or other committee members	Members get skills that enable them to manage and maintain the boreholes					
3	**SMEs**									
	SME training in sewing	Improve community ability to generate incomes through items that the mine will be supplied with	Women and men from community living in the mining footprint	People living within the license area	-Community producing items such as overalls, curtains, bed sheets, uniforms etc… - The mine is supplied from local community - Other mines are supplied by local community					

Table 86: SSDP Community and Staff Skills Transfer

ITEM NO	PROGRAM/ACTIVITY	OBJECTIVE	TARGET	TARGET COMMUNITY	ANTICIPATED OUTPUT	IMPLEMENTATION YEAR				
						2016	2017	2018	2019	2020
1	**AWARENESS AND IMMUNIZATION PROGRAMS**									
	HIV/AIDS	- Improve local community knowledge on HIV	Local community	Communities leaving into the mining footprint	- Local community have good knowledge of HIV (prevention, care, counseling…)					
	Immunization campaign	- Improve local community immunization against major outbreaks (Poliomyelitis, cholera…)	Local community	Communities leaving into the mining footprint	- Local community is immunized against major outbreaks (Poliomyelitis, cholera…)					
	Pre blasting awareness and survey	- Get local community aware about the planned blasting and assess asset status further to any blasting for grievance referral purpose.	Local community	Israel	- Local community is aware about the blasting plan and take necessary security measures. - Building assets are surveyed further to blasting					
2	**STAFF SKILL TRANFER**									
	Trainings, workshops	Build capacity within the sustainability team	Sustainability staff	Sustainability staff	Sustainability staff have skills to better perform their duty.					
	Experience sharing with other mining companies	Build capacity within the sustainability team	Sustainability staff	Sustainability staff	Sustainability staff have skills to better perform their duty.					

14.3.1 Schedule and Costs

Table 87: SSDP Budget and Schedule

No	PROGRAM	SOURCE OF FUNDS	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	Total
			$	$	$	$	$	$
1	Sensitization and facilitate the Creation and registration of co-operatives to enhance local Development	KAMOA SA /NGO	20,000	20,000	20,000			60,000
2	Support for Cultivation and planting of community maize, beans and Winter thorn trees for nitrogen retention in the soils	KAMOA SA	150,000	130,000	120,000	20,000		420,000
3	Support to Kamoa Copper SA joint farm	KAMOA SA/ Cooperative	103,000	80,000	60,000	20,000		
4	Training farmers in maize production, management and marketing	KAMOA SA	15,000	15,000	10,000			40,000
5	Establishment and strengthening of a maize milling plant to service cooperatives and Kamoa	KAMOA SA	20,000	10,000				30,000
6	Construction of maize satellite depots for storage of maize	KAMOA SA	20,000	20,000	20,000	20,000	20,000	100,000
7	Support to communities in Production of vegetable seedlings by use of improved agriculture equipment like vegetable tunnel systems and drip irrigation	KAMOA SA	30,000	30,000	20,000	10,000		90,000
8	Training communities in modern vegetable production, management and marketing	KAMOA SA	15,000	15,000	10,000			40,000
9	Construction of two poultry houses for Israel and Kaponda women	KAMOA SA	15,000	20,000				35,000
10	Training in Production, management and marketing of Broiler chicken and layers for communities	KAMOA SA	15,000	12,000	10,000			37,000
11	Training in improved and sustainable organic honey production, processing, packaging, marketing and production of materials	KAMOA SA	15,000	15,000				30,000
12	Creation of SMEs in Mushroom production	KAMOA SA		20,000	10,000			30,000
13	SME in carpentry, for furniture and etc.	KAMOA SA		45,000	30,000			75,000
14	SME in Sunflower and peanut production for cooking oil and peanut butter	KAMOA SA	25,000	10,000	8,000			43,000
15	SME to support women in sewing	KAMOA SA	30,000	20,000				50,000
16	Construction or rehabilitation of farmer training center	KAMOA SA		50,000	31,000			81,000
17	Strengthen partnerships with NGO having the same objectives as Kamoa Copper SA	KAMOA SA	20,000	15,000	10,000			45,000
18	Project Evaluation	KAMOA SA	10,000	10,000	10,000	10,000	10,000	50,000
Total			**503,000**	**537,000**	**369,000**	**80,000**	**30,000**	**1,519,000**

15.0 CERTIFICATION OF COMPLIANCE

KAMOA COPPER SA (Kamoa), through its Statutory Managers, Louis Watum: Managing Director of Kamoa Copper and Abraham Li: Deputy Managing Director of Kamoa Copper., hereby certifies that the present Environmental Impact Study, which also includes the Environmental Management Plan of the Project and the Sustainable Development Plan of the Kamoa Copper Mine Project belonging to Kamoa and to be carried out by Kamoa, has been prepared and conforms to the provisions outlined in the Environmental Impact Study Directive in Annex IX of the Mining Regulations.

The company further attests that the present EIS is a certified copy of that submitted to the approved Environmental Studies Office, African Mining Consultants Limited, entrusted with conducting the EIS.

For KAMOA COPPER SA,

(Signature)

____

Me Louis Watum

Managing Director

(Signature)

____

Me Abraham Li

Deputy Managing Director

GOLDER ASSOCIATES ZAMBIA (PTY) LTD

Nyundo Armitage Senior Environmental Consultant	Etienne Roux Principal Environmental Consultant

Reg. No. 119698

Directors: N Armitage, GL Michau

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APPENDIX A

Materials Safety Data Sheets (MSDS)

Safety Data Sheet

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name:	**SODIUM ISOBUTYL XANTHATE**
Other name(s):	SIBX; Carbonodithioic acid, O-(2-methylpropyl) ester, sodium salt; Isobutil xantato de sodio.
Recommended use of the chemical and restrictions on use:	Mineral floatation.
Supplier:	Ixom Operations Pty Ltd
ABN:	51 600 546 512
Street Address:	Level 8, 1 Nicholson Street Melbourne 3000 Australia
Telephone Number:	+61 3 9665 7111
Facsimile:	+61 3 9665 7937
Emergency Telephone:	**1 800 033 111 (ALL HOURS)**

Please ensure you refer to the limitations of this Safety Data Sheet as set out in the "Other Information" section at the end of this Data Sheet.

2. HAZARDS IDENTIFICATION

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.

This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:
Self-heating substances and mixtures - Category 1
Acute Oral Toxicity - Category 4
Acute Dermal Toxicity - Category 4
Skin Irritation - Category 2
Eye Irritation - Category 2A

SIGNAL WORD: DANGER

Hazard Statement(s):
H251 Self-heating; may catch fire.
H302+H312 Harmful if swallowed or in contact with skin.
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary Statement(s):

Prevention:
P235+P410 Keep cool. Protect from sunlight.
P264 Wash hands thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P280 Wear protective gloves / protective clothing / eye protection / face protection.

Response:
P301+P312 IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P330 Rinse mouth.
P302+P352 IF ON SKIN: Wash with plenty of soap and water.
P321 Specific treatment (see First Aid Measures on Safety Data Sheet).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P363 Wash contaminated clothing before re-use.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313 If eye irritation persists: Get medical advice/attention.
P312 Call a POISON CENTER or doctor/physician if you feel unwell.
P322 Specific measures (see First Aid Measures on Safety Data Sheet).

Storage:
P407 Maintain air gap between stacks/pallets.
P420 Store away from other materials.

Disposal:
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

Poisons Schedule (SUSMP): None allocated.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Proportion	Hazard Codes
Sodium isobutyl xanthate	25306-75-6	>60%	H251 H302 H312 H315 H319
Other minor ingredients	-	to 100%	-

4. FIRST AID MEASURES

For advice, contact a Poisons Information Centre (e.g. phone Australia 131 126; New Zealand 0800 764 766) or a doctor.

Inhalation:
Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. If patient finds breathing difficult and develops a bluish discolouration of the skin (which suggests a lack of oxygen in the blood - cyanosis), ensure airways are clear of any obstruction and have a qualified person give oxygen through a face mask. Apply artificial respiration if patient is not breathing. Seek immediate medical advice.

Skin Contact:
If skin or hair contact occurs, immediately remove any contaminated clothing and wash skin and hair thoroughly with running water. If swelling, redness, blistering or irritation occurs seek medical assistance.

Eye Contact:
If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre or a doctor, or for at least 15 minutes.

Ingestion:
Rinse mouth with water. If swallowed, do NOT induce vomiting. Give a glass of water. Seek immediate medical assistance.

Indication of immediate medical attention and special treatment needed:
Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media:
Coarse water spray, fine water spray, normal foam, dry agent (dry chemical powder). Use flooding amounts of water to stop the reaction; smothering will not work as this material does not need air to burn.

Hazchem or Emergency Action Code: 1Y

Specific hazards arising from the substance or mixture:
Substance liable to spontaneous combustion.

Special protective equipment and precautions for fire-fighters:
Avoid all ignition sources. Heating can cause expansion or decomposition of the material, which can lead to the containers exploding. If safe to do so, remove containers from the path of fire. Decomposes on heating emitting toxic fumes, including those of oxides of sulfur . Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to products of decomposition.

6. ACCIDENTAL RELEASE MEASURES

Emergency procedures/Environmental precautions:
Shut off all possible sources of ignition. Clear area of all unprotected personnel. If contamination of sewers or waterways has occurred advise local emergency services.

Personal precautions/Protective equipment/Methods and materials for containment and cleaning up:
Wear protective equipment to prevent skin and eye contact and breathing in vapours/dust. Air-supplied masks are recommended to avoid inhalation of toxic material. Vacuum solid spills instead of sweeping. Collect and seal in properly labelled containers or drums for disposal. Use non-sparking tools.

7. HANDLING AND STORAGE

Precautions for safe handling:
Avoid skin and eye contact and breathing in dust. In common with many organic chemicals, may form flammable dust clouds in air. For precautions necessary refer to Safety Data Sheet "Dust Explosion Hazards".

Conditions for safe storage, including any incompatibilities:
Store in a cool, dry, well ventilated place and out of direct sunlight. Store away from sources of heat or ignition. Store away from incompatible materials described in Section 10. Keep dry - reacts with water, may lead to drum rupture. Keep containers closed when not in use - check regularly for spills.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters: No value assigned for this specific material by Safe Work Australia. However, Workplace Exposure Standard(s) for decomposition product(s):

Carbon disulfide: 8hr TWA = 31 mg/m^3 (10 ppm), Sk

As published by Safe Work Australia Workplace Exposure Standards for Airborne Contaminants.

TWA - The time-weighted average airborne concentration of a particular substance when calculated over an eight-hour working day, for a five-day working week.

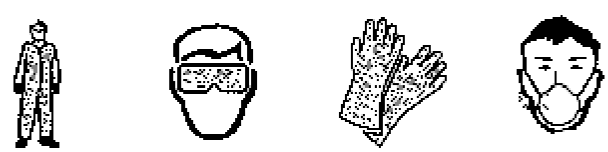
`Sk' (skin) Notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

These Workplace Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These workplace exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Appropriate engineering controls:
Ensure ventilation is adequate and that air concentrations of decomposition product(s) is/are controlled below quoted Exposure Standards. Avoid generating and breathing in dusts. Use with local exhaust ventilation or while wearing dust mask. Keep containers closed when not in use.

Individual protection measures, such as Personal Protective Equipment (PPE):
The selection of PPE is dependent on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors.

OVERALLS, SAFETY SHOES, CHEMICAL GOGGLES, GLOVES, DUST MASK.



Wear overalls, chemical goggles and impervious gloves. Avoid generating and inhaling dusts. If determined by a risk assessment an inhalation risk exists, wear a dust mask/respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Solid
Colour:	Yellow to Green
Odour:	Slight Sulfur
Molecular Formula:	(CH3)2CHCH2-O-(C=S)S.Na
Solubility:	Soluble in water.
Specific Gravity:	1.17-1.18
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	Not available
Flash Point (°C):	Not available
Flammability Limits (%):	Not available
Autoignition Temperature (°C):	Not available
Melting Point/Range (°C):	Not available
pH:	Not applicable

10. STABILITY AND REACTIVITY

Reactivity: Reacts with water. Reacts with acids.

Chemical stability: Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

Possibility of hazardous reactions: Reacts exothermically with water . Heating can cause expansion or decomposition of the material, which can lead to the containers exploding.

Conditions to avoid: Avoid exposure to moisture. Avoid exposure to heat, sources of ignition, and open flame.

Incompatible materials: Incompatible with oxidising agents , acids , copper , copper alloys .

Hazardous decomposition products: Oxides of sulfur. Carbon disulphide. Carbonyl sulfide.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing may result in irritation of the gastrointestinal tract.

Eye contact: An eye irritant.

Skin contact: Contact with skin will result in irritation. Will liberate carbon disulfide upon contact with moist skin. Carbon disulfide can be absorbed through the skin with resultant adverse effects.

Inhalation: Breathing in dust may result in respiratory irritation. Inhalation of carbon disulfide vapour can cause severe mood and personality disturbances including excitability, confusion and irritability. Exposure to high vapour concentrations can result in coma.

Acute toxicity:
Oral LD50 (rat): 1000 mg/kg

Chronic effects: Not listed as carcinogenic according to IARC.

12. ECOLOGICAL INFORMATION

Ecotoxicity Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal methods:
Refer to Waste Management Authority. Dispose of material through a licensed waste contractor. Advise flammable nature.

14. TRANSPORT INFORMATION

Road and Rail Transport

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.

UN No:	3342
Transport Hazard Class:	4.2 Spontaneously Combustible
Packing Group:	III
Proper Shipping Name or Technical Name:	XANTHATES
Hazchem or Emergency Action Code:	1Y

Marine Transport

Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea; DANGEROUS GOODS.

UN No:	3342
Transport Hazard Class:	4.2 Spontaneously Combustible
Packing Group:	III
Proper Shipping Name or Technical Name:	XANTHATES

IMDG EMS Fire:	F-A
IMDG EMS Spill:	S-J

Air Transport

Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air; DANGEROUS GOODS. TRANSPORT PROHIBITED under the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air in Passenger and Cargo Aircraft; may be transported by Cargo Aircraft Only.

UN No:	3342
Transport Hazard Class:	4.2 Spontaneously Combustible
Packing Group:	III
Proper Shipping Name or Technical Name:	XANTHATES

15. REGULATORY INFORMATION

Classification:
This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:
Self-heating substances and mixtures - Category 1
Acute Oral Toxicity - Category 4
Acute Dermal Toxicity - Category 4
Skin Irritation - Category 2
Eye Irritation - Category 2A

Hazard Statement(s):
H251 Self-heating; may catch fire.
H302+H312 Harmful if swallowed or in contact with skin.
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Poisons Schedule (SUSMP): None allocated.

This material is listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

This safety data sheet has been prepared by Ixom Operations Pty Ltd Toxicology & SDS Services.

Reason(s) for Issue:
Revised Primary SDS
Change in Fire Management Requirements
Change to Transport Information
Alignment to GHS requirements

This SDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Ixom Operations Pty Ltd cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Ixom representative or Ixom Operations Pty Ltd at the contact details on page 1.

Ixom Operations Pty Ltd's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

APPENDIX B

Stakeholder Engagement Records

October 2016

KAMOA COPPER SA

Report on stakeholder engagement during Terms of Reference

Submitted to:
Kamoa Copper SA
Province of Lualaba
Democratic Republic of Congo

REPORT

Report: 1653699-314773-2

Distribution:

1 x electronic copy Kamoa Copper SA
1 x electronic copy inMagic
1 x electronic copy Golder project folder

Golder Associates

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Stakeholders database

APPENDIX B
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1.0 INTRODUCTION

This document provides a summary of the public consultation process for the Kamoa Project EIS update. The public consultation process is being conducted by Golder Associates with the assistance of Kamoa's Community Liaison Officers (CLOs), the latter of whom all are local Congolese fluent in French and local Swahili.

2.0 REGULATORY REQUIREMENTS, GUIDELINES AND STANDARDS

From a local perspective, the public consultation process complies with the provisions of the DRC Mining Regulations (Annexe IX of Decree No. 038/2003 (26/03/ 2003), Part VII, Article 126) for public consultation; the DRC Environment Code (Fundamental principles relating to the Protection for the Environment (law No 11/009 of 9 July 2011).

3.0 OBJECTIVES OF THE PUBLIC CONSULTATION

The public consultation process is designed to consult with interested and affected parties (I&AP) for use throughout the EIS update process, thus providing organisations and individuals with an opportunity to raise concerns and make comments and suggestions regarding the proposed Project. By being part of the assessment process, stakeholders have the opportunity to influence the Project layout and design as well as the plan of study (Terms of Reference) of the EIS update.

The process is being conducted in French and local Swahili.

Specific objectives, divided into the stages of the EIS, are described in Box 1 – 1.

Box 1-1. Objectives of public consultation during the EIS Update

The objectives of public consultation for the EIS update are to provide sufficient and accessible information to stakeholders in an objective manner to assist them to:

During Scoping / Terms of Reference:

- Understand the context of this EIS update in terms of the previous EIS to DRC standards;
- Become informed and educated about the proposed Project and its potential impacts;
- Identify issues of concern, suggestions for enhanced benefits and commenting on alternatives, contribute local knowledge and experience; and
- Verify that their comments, issues of concern and suggestions have been captured and considered in the Terms of Reference (ToRs) for the impact assessment.

During the Impact Assessment Phase:

- Verify that their issues and suggestions have been evaluated and feedback has been provided to them;
- Comment on the findings of the EIS update; and
- Identify further issues of concern from the findings of the EIS update.

During the Approvals Phase:

- Provide stakeholders with information on whether or not the DRC government has approved the updated EIS.

Figure 1: Objectives of public consultation

3.1 APPROACH

IFC PS 1 stipulates that stakeholder consultation should include elements of capacity building to ensure the process is considered "free, prior and informed". This was done by:

- Providing accessible and adequate information without creating undue fears (related to potential negative impacts) or expectations (regarding jobs);
- Using visual illustrations and verbal explanations for illiterate stakeholders; and

- Using local languages and small groups to ensure stakeholders did not feel intimidated.

Public consultation process started in October 2016 comprises of the following steps:

- Stakeholder database development;
- ToR Consultation (05 – 09 October 2016); and
- Ongoing consultation by Kamoa.

3.1.1 Development of Stakeholder Database

A stakeholder database and matrix were developed containing a list of stakeholders, ranked according to the sectors of the company covering Lubumbashi, Kolwezi, Kinshasa, Likasi and Kamoa. The database contains the contact details of the stakeholders and the archives of each stakeholder interaction, e.g. E-mails, meetings, etc.

In addition, the database also links stakeholders to the issues they raised during the project.

The involvement of the following groups or organisations in the public consultation process is considered to be particularly important:

- Relevant DRC Government authorities at the District levels;
- Directly affected communities (Project Affected People (PAPs);
- Environmental groups and Non-Governmental Organisations (NGO)s;
- Community Based Organisations;
- Local companies potentially related to the mining industry;
- Academic/research organisations;
- Local communities; and
- The media.

4.0 CONSULTATION DURING THE TERMS OF REFERENCE

During the public consultations held, **627 people** have been registered and **186 issues** and concerns have been raised and recorded. Issues and concerns raised during the public consultations are summarized as follows:

- **Employment issues**
  - Most of project affected people have voiced concerns over the transparency on recruitment process.
  - Some participants indicated that Kamoa subcontractors and contractors had to be identified and should start employing from the Lualaba Province.
  - Surrounding local communities should be prioritized in the employment process at all positions.
  - Communities living alongside the new road to be constructed from the Kolwezi airport to the Kamoa site should be the first communities to be employed for unskilled positions.
  - Communities not being within the Kamoa project areas should also benefit from employment opportunities as those who are from Mwilu / Walemba.
  - People were concerned on the limited number time given to casuals (21 days).
- **Issues on community development projects**

- Most of the people from the local community would like Kamoa to build more schools and community clinics in each local community around Kamoa.
- Local community would like an update be given on the integration between local development plan of Lufupa Sector and Kamoas commitment.
- Support is requested for agricultural inputs to farmers not only living in the project area but also those grouped in developmental NGOs.
- A follow up is required to be done as regards good working conditions of water tanks provided in the Israel village which is now running out of water due to the box cut work.
- NGOs have expressed wishes to always be associated with Kamoa sustainable development projects.
- There is an increased need of potable water within local communities.
- Rehabilitating roads within the local communities.

- **Issues related to the environmental impacts**
  - Several participants raised concerns of seeing the air polluted by the mining activities at Kamoa, in particular with the smoke that will be released into the air.
  - The population would like the tailings storage facilities not to be close to a river or a local water source.
  - The project should propose a waste disposal management plan.
  - Some participants in the meetings wanted to know the mitigation measures for the identified impacts.
  - Not far from the Mundjendje community, some wells have been dug by Kamoa as part of the survey and are never covered to date, which is a risk to the entire community.
  - Some participants were concerned over the speeding of project vehicles in villages that could cause a lot of damage to people and animals.
  - The local population is concerned about the dust that comes from the regular traffic of Kamoa and its subcontractors and had caused several diseases.
  - Participants have recommended that the company place speed bumps along roads, particularly in local communities, in order to limit the damage caused by speeding.

- **Issues related to the Project**
  - Some participants expressed wishes to see Kamoa first evaluate the Environmental Impact Assessment submitted in 2011, the positive and negative aspects that have been achieved to date.
  - Local communities wanted to know when was mining going to start at Kamoa and which of the KAKULA or KANSOKO deposits would be prioritized.
  - People wanted the new constructed road from Kolwezi airport to Kamoa mine to be paved.
  - Most NGOs suggest the construction of workers' camps or other infrastructure is made of durable materials and not prefabricated.
  - Human Rights and Environmental NGOs were concerned about the wage differential between expatriates and nationals that is very large.
  - Stakeholders wanted to know the emergency response plan in the event of a mine collapse.

- Community members suggest that public consultation be announced to local communities several days in advance.
- Traditional leaders have complained that their claims have never been satisfied positively, this was said by Muvunda chief, saying that a list of commitments was signed between him and the company, and nothing has been done so far. He threatened not to participate in the opening ceremony of Kakula.
- People would like any promise made to local communities be done.

To ensure that the views of stakeholders, interested parties and those directly or indirectly affected are taken into account in the preparation of the terms of reference, the following meetings were held:

Table 1: Summary of meetings held – Consultations during the Terms of Reference of the EIS of Kamoa

Date	Venue	Time	Type of meetings
05-10-16	Salle de réunion du Gouvernorat de Province	11 – 12	Public meeting
05-10-16	SALLE HERAIS - Croisement des avenues Lusanga et des pins, C/Dilala, à KOLWEZI	14 – 17	Open House
06-10-16	Bureau de l'Administrateur du territoire de Mutshatsha	12 – 14	Public Consultation
06-10-16	Palais du chef Muvunda	10 – 12	Public Consultation
06-10-16	Bureau du chef secteur Lufupa	12 – 14	Public Consultation
06-10-16	Bureau du Chef Secteur Luilu	10 – 12	Public Consultation
06 – 10 - 16	Bureau du Chef de Groupement Mwilu	09 - 11	Public Consultation
07 – 10- 16	Université de Kolwezi	10 - 12	Public Consultation
07 – 10- 16	Cité Maseka	14 – 16	Public Consultation
08 – 10 -16	Kyamadingi	10 - 12	Public Consultation
08 – 10- 16	Mundjendje	10 - 12	Public Consultation

4.1.1 Invitations and presentations

Invitation letters were issued prior to meetings with identified stakeholders and community leaders visited by Kamoa community liaison officers to agree on the venue and time of the meeting.

NOTIFICATION DE L'ÉTUDE D'IMPACT ENVIRONNEMENTAL

PROJET DE KAMOA:
MISE À JOUR DE L'ÉTUDE D'IMPACT ENVIRONNEMENTAL, PROVINCE DE LUALABA, RDC

LES MEMBRES DE LA COMMUNAUTE INTERESSES SONT INVITES A ASSISTER A UNE REUNION PORTE OUVERTE

SALLE HERAIS - Croisement des avenues Lusanga et des pins, C/Dilala, à KOLWEZI

MERCREDI 05 OCTOBRE 2016 DE 14: 00 – 16: 00

DISCUTER DE LA MISE A JOUR DE L'ETUDE D'IMPACT ENVIRONNEMENTAL DU PROJET DE CUIVRE DE KAMOA

Kamoa Copper SA, une filiale d'Ivanhoe Mines, est en train de développer une mine de cuivre à Kamoa près de Kolwezi dans la Province de Lualaba, en République Démocratique du Congo (RDC).

Kamoa Copper SA est requis par la réglementation minière en RDC de mettre à jour son étude d'impact environnemental approuvé une fois tous les 5 ans pour intégrer les changements au projet.

L'EIE originale a été approuvée en Novembre 2011, et donc Kamoa est tenu de soumettre une EIE mise à jour au gouvernement d'ici la fin de l'année 2016.

Kamoa a désigné Golder Associates RDC SARL (Golder) pour mettre à jour l'étude d'impact environnemental (EIE).

Kamoa et Golder tiendront une réunion porte ouverte à HERAIS – KOLWEZI, ce MERCREDI 5 OCTOBRE 2016 de 14 :00 à 16 :00. Cette réunion fournira des informations sur le projet, ainsi que le processus de l'EIE. Elle sera également l'occasion pour le public de poser des questions et faire des commentaires et des suggestions sur toutes les questions environnementales et sociales liées au Projet.

Kamoa Copper SA
Guy Muswil
Directeur des Relations Communautaires
Phone : +24 3818304307
Email : guym@ivanplats.com

KAMOA COPPER SA
Une filiale d'IVANHOE MINES

Golder Associates

KAMOA COPPER SA

Une filiale d'IVANHOE MINES

INVITATION

Invitation pour commenter la mise à jour du Projet de Cuivre de Kamoa : Termes de Reference pour une mise à jour d'Etude d'Impact Environnemental et Social.

Cher Monsieur / Chère Madame,

Kamoa Copper SA, une filiale d'Ivanhoe Mines, est en train de développer une mine de cuivre à Kamoa près de Kolwezi dans la Province de Lualaba, en République Démocratique du Congo (RDC).

Kamoa Copper SA est requis par la réglementation minière en RDC de mettre à jour son étude d'impact environnemental approuvé une fois tous les 5 ans pour intégrer les changements au projet.

L'EIE originale a été approuvée en Janvier 2012 et donc Kamoa est tenu de soumettre une EIE mise à jour au gouvernement d'ici la fin de l'année 2016.

Golder Associates comme bureau indépendant d'études environnementales et sociales avait été sélectionné à mettre à jour ces études aux normes de la RDC.

L'EIE évaluera les impacts positifs et négatifs potentiels du projet, et proposera des mesures d'atténuation pour réduire les impacts négatifs et renforcer les effets positifs. Le processus commence par l'élaboration d'un cadre de référence (TdR) qui devra définir ce qui sera évalué dans l'EIE et de quelle manière.

Une fois le mandat est approuvé par la Direction de Protection de l'Environnement Minier (DPEM), l'EIE est effectuée et les résultats sont documentés dans une étude d'impact environnemental (EIE). L'EIE est soumise à la DPEM pour décision

Kamoa et Golder tiendront une journée porte ouverte dans la **salle HERAIS - Croisement des avenues Lusanga et des pins**, Commune de Dilala à KOLWEZI **le Mercredi 05 Octobre 2016**, de 14 heures à 16 heures.

Cette journée porte ouverte sera l'occasion de poser des questions et faire des commentaires et des suggestions relatives à tout enjeu environnemental et sociaux du Projet afin que ceux-ci soient évalués dans l'EIE.

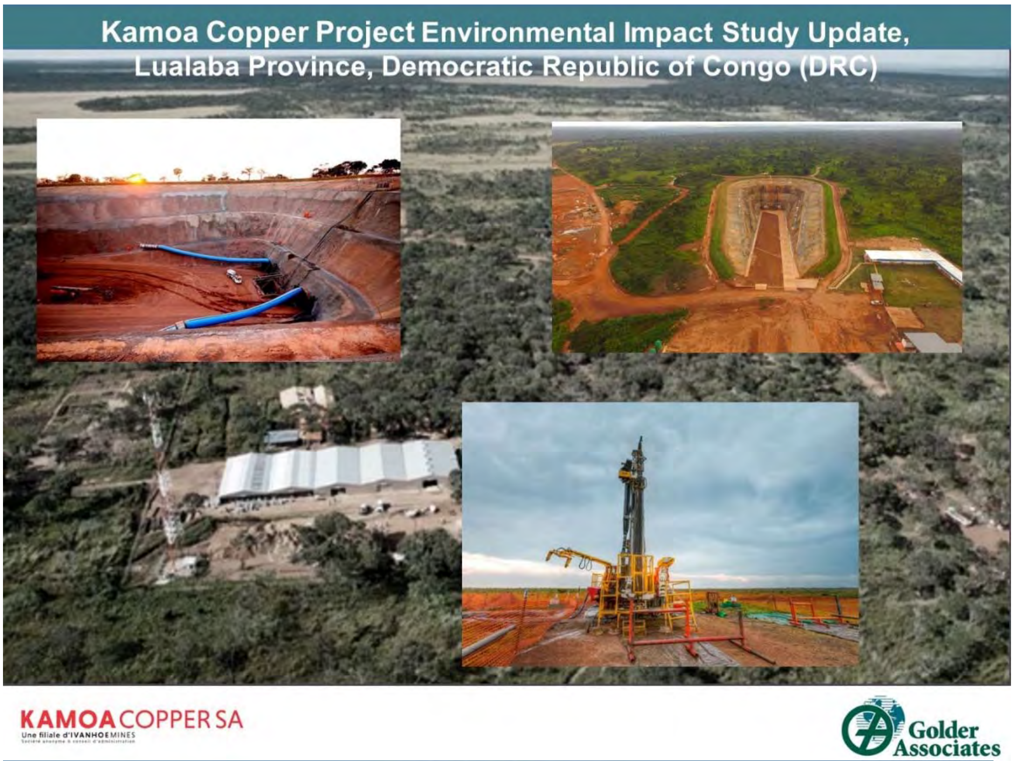
Votre présence est vivement souhaitée.

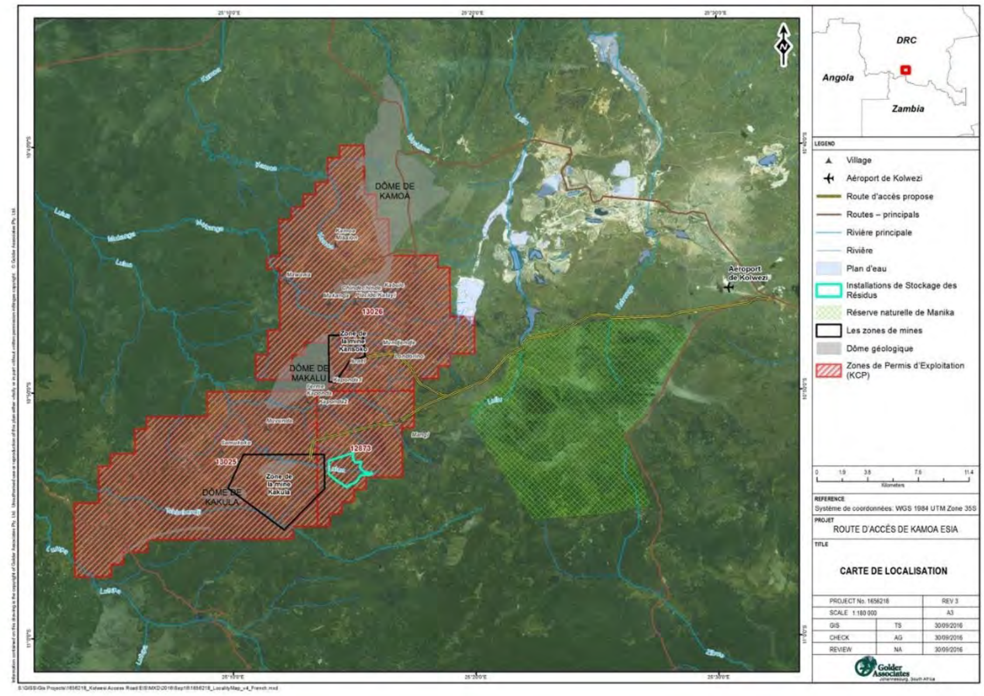
La Direction

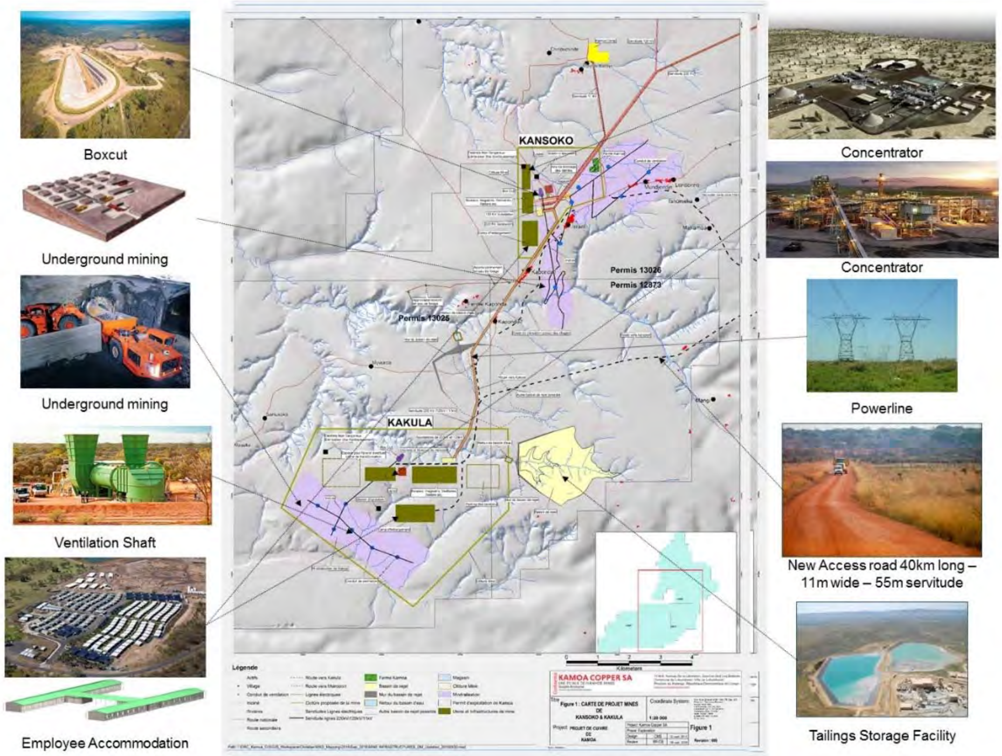
Figure 2: An example of a letter of invitation

4.2 Posters and Background Information Documents

At each meeting, Kamoa representatives and the EIA team presented a series of posters and provided participants with a background information document. Each set of posters and information document was available in French at the request of local communities.




DRC
Angola
Zambia
LEGEND
Village
Aéroport de Kolwezi
Route d'accès proposé
Routes – principals
Rivière principale
Rivière
Plan d'eau
Installations de Stockage des Résidus
Réserve naturelle de Manika
Les zones de mines
Dôme géologique
Zones de Permis d'Exploitation (KCP)
DÔME DE KAMOA
DÔME DE MAKALU
DÔME DE KAKULA
Aéroport de Kolwezi
13026
12873
13025
REFERENCE
Système de coordonnées: WGS 1984 UTM Zone 35S
PROJET
ROUTE D'ACCÈS DE KAMOA ESIA
TITLE
CARTE DE LOCALISATION
Golder Associates


Boxcut
Underground mining
Underground mining
Ventilation Shaft
Employee Accommodation
KANSOKO
KAKULA
Permis 13026
Permis 12873
Permis 13025
KAMOA COPPER SA
Concentrator
Concentrator
Powerline
New Access road 40km long – 11m wide – 55m servitude
Tailings Storage Facility

ENVIRONMENTAL IMPACT STUDY UPDATE

Kamoa Copper SA has appointed Golder Associates DRC SARL (Golder) to undertake the Environmental Impact Study (EIS) update to ensure the proposed Project expansion is conducted in accordance with the DRC Mining Code.

Public consultation to provide information and allow you to contribute knowledge and raise concerns

We are here

1. **Terms of Reference (ToR)**
   Identify impacts to be assessed in the EIS
2. **Impact Assessment Process**
   Detailed studies of environmental and social impacts, both positive and negative
3. **Environmental Impact Study (EIS)**
   Report on the findings of the impact assessment - includes an Environmental Management Plan for the Project (EMPP)
4. **Decision Making Phase**
   EIS submitted to the Department for Protection of the Mining Environment (DPEM) They use the findings of the EIS to decide if the project should proceed and if so under what conditions

The draft EIS update will be made available for comment in November 2016.

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IMPACT ASSESSMENT AND MITIGATION

Golder will update the EIS based on detailed specialist studies on:

- Air quality;
- Noise and vibration;
- Soils, landuse and land capability;
- Surface water;
- Groundwater;
- Geochemistry;
- Ecology (terrestrial and aquatic);
- Socio-economic; and
- Cultural heritage and archaeology.

Mitigation measures will be identified in order to minimise negative impacts and to enhance positive impacts.

Potential Project issues and impacts that are important to you should be communicated to the EIS update team.

Examples of Mitigation Measures

Dust suppression

Avoid sensitive areas'

Rehabilitation

Vehicle maintenance

Community development

Consultation

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Figure 3: Posters presented

EIS PROCESS

In terms of Law No. 007/2002 of July 11 2002 and Decree No 038/2003 of 26 March 2003 of the Mining Code an **Environmental Impact Study (EIS)** update for the project is required.

The EIS update will re-evaluate the potential positive and negative impacts of the project, and update the mitigation measures to reduce negative impacts and enhance positive impacts.

The process commences with the development of a **Terms of Reference (ToR)** defining what will be assed in the EIS update and how.

Once the ToR is approved by the **Department in charge of the Protection of the Mining Environment (DPEM)** the EIS is carried out and the findings are documented in an **Environmental Impact Statement (EIS) update**. The EIS update is then submitted to DPEM for a decision.

Public Consultation

1. **Terms of Reference (ToR)**
   Identify impacts to be assessed in the EIS
2. **Impact Assessment Process**
   Detailed studies of environmental and social impacts, both positive and negative
3. **Environmental Impact Study (EIS)**
   Report on the findings of the impact assessment - includes an Environmental Management Plan for the Project (EMPP)
4. **Decision Making Phase**
   DPEM use the findings of the EIS to decide if the project should proceed and if so under what conditions

PUBLIC CONSULTATION

Kamoa Copper SA wish to ensure that the public is consulted throughout the EIS update process to provide communities with the opportunity to raise concerns, contribute local knowledge and make suggestions that can improve the Project design. Opportunities to participate will be communicated by Kamoa Copper SA.

To provide any comments or to request additional information please contact:

Kamoa Copper SA **Guy Muswil** **Community Relations Manager** **Phone : +243818304307** **Email : guym@ivanplats.com**	**Golder Associates DRC SARL** **Serge Kayembe** **Stakeholder Engagement Specialist** **Phone : +243995738415** **Email : SKayembe@golder.com**

YOUR COMMENT IS IMPORTANT

Your comments on any aspect of the proposed Kamoa Copper Project EIS update and public consultation process will assist the EIS update team and allow the authorities to make an informed decision about the Project.

BACKGROUND INFORMATION

A world of capabilities delivered locally

October 2016

KAMOA COPPER PROJECT ENVIRONMENTAL IMPACT STUDY UPDATE, LUALABA PROVINCE, DEMOCRATIC REPUBLIC OF CONGO

KAMOA COPPER SA
Une filiale d'IVANHOE MINES

Golder Associates

PROJECT DESCRIPTION

The Kamoa Copper Project (Kamoa Copper SA) - a joint venture between Ivanhoe Mines and Zijin Mining Group Co. Ltd., is in the process of developing two copper mines at Kamoa near Kolwezi in the Lualaba Province of the Democratic Republic of Congo (DRC). Kamoa Copper SA is required by DRC mining regulations to update its approved Environmental Impact Study (EIS) once every 5 years to incorporate changes to the Project. The original EIS was approved in January 2012, and therefore Kamoa is required to submit an updated EIS to government by the end of 2016.

Kamoa Copper SA is in the process of developing an underground mine at Kansoko, within the Kamoa permit area, the development of the declines to access the ore started in mid-2016. In the last year, Kamoa discovered another rich copper deposit within their mine concession area, known as Kakula. It is located approximately 12 km south of the current Kansoko development area. Kamoa is amending its project development strategy to include Kakula and intends to develop the mines as follows:

- Construction of a 4 million tonnes per annum (Mtpa) underground mine and concentrator plant at Kakula;
- Continued development of the 4 Mtpa mine at Kansoko, including the construction of a concentrator plant;
- Construction of a central tailings storage facility (TSF) at Kakula to dispose of waste tailings from both the Kansoko and Kakula concentrator plants; and
- Supporting infrastructure will include access roads within the licence area, powerline extension, construction camps, lay down areas, new road infrastructure within the Project area and a new main access road between the project area and Kolwezi airport.

Kamoa Copper SA has appointed Golder Associates DRC SARL (Golder) to undertake the Environmental Impact Study (EIS) update.

EMPLOYMENT
The proposed Kamoa Project will employ 2000-3000 personnel during the peak of construction, reducing to 1500-2000 during operations. The road construction will require 60-100 contract workers.

Twin declines at the Kansoko box cut that are to provide access to the planned underground mine

New road to be constructed from Kamoa Copper Project concession area to Kolwezi Airport

Example of a TSF

Example of a Concentrator Plant

Proposed Manika Nature Reserve

Figure 4: Background Information Document

5.0 PUBLIC CONSULTATIONS – GOUVERNOR'S OFFICE - PROVINCE OF LUALABA

5.1 Attendance register

The following stakeholders attended the public meeting in the official residence of the Governor of Province of Lualaba on 05 October 2016.

Table 2: Attendance Register – Public Consultations – Gouvernor's house of Lualaba

Name	Organization	Address	Telephone
Mr Richard Muyej	Gouvernor of the Province of Lualaba	Kolwezi	-
Mr Ngoie Kazadi	Environmental Coordinator	Kolwezi	+243813845291
Mr Mashata Kayembe	Chief of staff of the Provincial minister of Environment	Kolwezi	+243997124795
Mrs Muhaila Pitshi	Advisor to the Governor of Lualaba	Kolwezi	+243997016907
Mr Kapenda wa Kapenda	Assistant to the Governor	Kolwezi	-

5.2 Photographs – Meetings in the Conference room

5.3 Summary

A total of 6 observations and questions were recorded during the meeting. The main comments were:

- Job creation at Kamoa to fight the rate of unemployment in Kolwezi
- Hiring of local specialists in Lualaba Province by Golder Associates
- Specific aspects of the EIA update for Kamoa.
- More questions about the schedule and start of mining operations at Kamoa.

- The involvement of environmental experts of the Provincial Government in the updating of the Environmental Impact Study for Kamoa.

6.0 OPEN HOUSE – KOLWEZI

6.1 Attendance register

The following stakeholders attended the open house session in the city of Kolwezi on Wednesday, October 5, 2016.

Table 3: Attendance register – OPEN HOUSE – Kolwezi

Name	Organization	Address	Telephone
Mr Tsimba Mbabu	Liberal	Kolwezi	+243998620379
Mr Ungana Kahilu	Pasteur	Kolwezi	+243817702736
Mr Mikombe Kasongo	Medecin	Kolwezi	+243810207711
Mr Ilunga Kazembe	Liberal	Kolwezi	+243995220063
Mr Musapana Kabamba	Services affaires sociales de Kolwezi	Kolwezi	+243817446377
Mr Kumba Tshibwete	Agent SICOMINES	Kolwezi	+243995272896
Mr Muzenga Mwema	Service Plan	Kolwezi	+243997029720
Mr Kowa Kyungu	Student	Kolwezi	+243999521393
Mr Tshiku Kamb	Student	Kolwezi	+24397734364
Mr Ngoie Mwana Tambwe	Student	Kolwezi	+243990535577
Mr Ilunga Kayembe	Gerant Herais	Kolwezi	+243994593175 / +243811613270
Mr Tshinyeta Kasongo	Chef de division AGRIPEL	Kolwezi	+243997030754
Mr Munung Mwatshond	Chef de cellule de Geologie et Mines	Kolwezi	+243970063819
Mr Wadiese Kitwa	Ir Civil metallurgiste	Kolwezi	+243970318089
Mr Malambu Sany	Professeur	Kolwezi	+243976270001
Mr Kayombo Mbumba	Chef de service urbain culture et arts	Kolwezi	+243990333468
Mr Mufuk Riy	Chef de service dev urbain / rural	Kolwezi	+243991064700
Mr Ngombe Wanshimba	Representant legal de la convention des eglises pentecotistes afrique mission (C.E.P.A.M)	Kolwezi	+2439982311627
Mr Kazadi Katshinda	Agent Reliant Congo	Kolwezi	+243811850642
Mr Banza Mwape	Maitre Avocat	Kolwezi	+243997108265
Mr Kata Lukunga	Association des Farmers (Maendeleo)	Kolwezi	+243812605964
Mr Kamana Tshipulenu	Chef service genre et famille	Kolwezi	+243992528534
Mrs Ann Gallen	Kampi ya Boma	Kolwezi	+243818320452
Mr Mwinkeu A Kawey	Student	Kolwezi	+243975666702
Mr Kyundu Kazonda	Ir Civil Metallurgiste	Kolwezi	+243993671017

Name	Organization	Address	Telephone
Mrs Tshingwe Kaj	Presidente de l'Association pour le developpement" Mama ni Mama"	Kolwezi	+243813496761
Mr Kapenda Lemesa Pegle	Association des Farmers Maendeleo	Kolwezi	+243819512340
Mr Mbweti Ilunga	Farmer	Kolwezi	+243811697150
Mr Musas Wakutshiz Joseph	Student	Kolwezi	+243970936796
Mr Kayij Kayemb Freddy	Student	Kolwezi	+243979511100
Mr Bukasa Tshibanda Aubin	Liberal	Kolwezi	+243993687215
Mr Ngoie Mbidi	Agent Rulco	Kolwezi	+2439700295771
Mr Kamweni Sakauta	Student	Kolwezi	+243815401415
Mr Lenge Shalom	Liberal	Kolwezi	+243999505058
Mr Tshibumbu Kabashi	Farmer	Kolwezi	+243851625977
Mr Elijah Mwamba	Entrepreneur	Kolwezi	+243997823939
Mr Kayenge Numbi	Liberal	Kolwezi	+243993303659
Mr Ilunga Kashala	Informaticien	Kolwezi	+243990378001
Mr Kabashi Naweji	Commercant	Kolwezi	-
Mr Mayiyi Kema herve	Liberal	Kolwezi	-
Mr Muyumba Mbiana	Electricien	Kolwezi	+243993993004
Mr Muleyi Mwamba	Student	Kolwezi	+243995411099
Mr Yumbu Lukuba	Division de l'environnement	Kolwezi	+243813806808
Mr Kabulo Numbi	Liberal	Kolwezi	-
Dr Masonj Mulelemu	Division Provinciale de la sante	Kolwezi	+243810179874
Mrs Kamango Mpanga Esther	Liberal	Kolwezi	+243816160808
Mr Ilunga Ngoy Serge	Ingenieur mecanicien	Kolwezi	+243814385577
Maitre Kitwa Daudet	ONG ADDH	Kolwezi	+243997025716 daudetkitwa@yahoo.fr
Mr Tshaz Mwaku	Liberal	Kolwezi	-
Mr Tshimbalanga Kabamba	Student	Kolwezi	+243821982058 - +243995860070
Mr Mugho Walumbu	Liberal - Ingenieur	Kolwezi	+243995888164 - +243811769597
Mr Ngoja Mambo	Teacher	Kolwezi	+243970186414 - +243858573278
Mr Mako Bakajika	Medecin	Kolwezi	+243814650797 +243991474863
Mr Ngoy Bikunga	Ingenieur civil - liberal	Kolwezi	+243993304360 +243815026959

Name	Organization	Address	Telephone
Mr Ngoie Kabuya	Commandant Police de Mines et hydrocarbure Lualaba	Kolwezi	+243997147881 +243814746960
Mr Kasongo Kilumba	Informaticien	Kolwezi	+243979522333
Mr Muzala Kakoma	ONG ADDH	Kolwezi	+243995044449 +243816835524

6.2 Photographs – Open house – Kolwezi


6.3 Summary

A total of 102 observations and questions were recorded during the meeting. The main comments were:

- Job creation.
- Assistance by Kamoa in the creation of vocational schools.
- Community development projects.
- Prevention and preservation of the environment.
- Agricultural assistance to all farmers.
- Transparency in the recruitment process.
- The tailings storage facility to be located far from a river.
- Risk of contamination or pollution of communities near the site or offices within the site.

- New road to be built between Kolwezi airport and the mine to be tarred.
- Comparison between the first social and environmental impact assessment and the one that is currently being revised.
- Review the 5% increase as a share of the State in mining companies
- Choice of prioritization between the Kansoko and Kakula deposits
- The updating of the harmonization of the Lufupa local development plan and Kamoa commitment is to be communicated to all
- Presentations of mitigation measures against deforestation during the road construction between Kolwezi road and Kamoa mine.

7.0 PUBLIC CONSULTATIONS – MWILU

7.1 Attendance Register

The following stakeholders attended the public meeting at the Royal Palace of Mwilu on Thursday, 06 October 2016.

Table 4: Attendance Register – Public meeting – Mwilu

Name	Organization	Address	Telephone
Mr Mwilu Kashiki wa Bulongo	Chef de Groupement Mwilu	Mwilu	+243995218411
Mr Kabotwe Munena	Chef Konga	Mwilu	-
Mr Kabwita Masengo	Chef Ntunga	Mwilu	-
Mr Kibale John	Chef Walemba	Mwilu	+243995868355
Mr Mambwe Mwanza	Chef Kyamadingi	Mwilu	-
Mr Mwema Kifunga	Chef Kangalele	Mwilu	-
Mr Ilunga Kisafu	Farmer	Mwilu	+243974693820
Mr Kabutue Kasongo	Farmer	Mwilu	-
Mr Mumba Ilunga	Farmer	Mwilu	-
Mr Mitonga Maloba	Farmer	Mwilu	-
Mr Kanamina Kabunda	Farmer	Mwilu	+243898066346
Mr Mwepu Kabotwe	Farmer	Mwilu	+243994215838
Mr Ilunga Kawanda	Farmer	Mwilu	+243994241333
Mr Ilunga Kisama	Farmer	Mwilu	+243995728274
Mr Kaumba Lipengo	Farmer	Mwilu	-
Mr Kibalasa Kipanda	Farmer	Mwilu	-
Mr Mumba Gaspard	Farmer	Mwilu	-
Mr Ngoie Muke	Farmer	Mwilu	+243976656763
Mr Mwilu Kashiki wa Bulongo	Chef de Groupement Mwilu	Mwilu	+243995218411
Mr Kabotwe Munena	Chef Konga	Mwilu	-
Mr Kabwita Masengo	Chef Ntunga	Mwilu	-
Mr Kibale John	Chef Walemba	Mwilu	+243995868355
Mr Mambwe Mwanza	Chef Kyamadingi	Mwilu	-

Name	Organization	Address	Telephone
Mr Mwema Kifunga	Chef Kangalele	Mwilu	-
Mr Ilunga Kisafu	Farmer	Mwilu	+243974693820
Mr Kabutue Kasongo	Farmer	Mwilu	-
Mr Mumba Ilunga	Farmer	Mwilu	-
Mr Mitonga Maloba	Farmer	Mwilu	-
Mr Kanamina Kabunda	Farmer	Mwilu	+243898066346
Mr Mwepu Kabotwe	Farmer	Mwilu	+243994215838

7.2 Photographs – PUBLIC CONSULTATIONS – MWILU

7.3 Summary

A total of 5 observations and questions were recorded during the meeting. Here are the main comments:

- Kamoa to employ people at Walemba and Mwilu.
- Promotion of Agroforestry in the Mwilu Grouping or the Project Area.
- Implementation of Community Development Committees in villages where they do not yet exist.

8.0 PUBLIC CONSULTATION – SECTEUR LUFUPA

8.1 Attendance Register

The following stakeholders attended the public meeting at Musokantanda on Thursday, 06 October 2016

Table 5: Attendance Register – Public consultation – Musokantanda

Name	Organization	Address	Telephone
Mr Kabwita Beya	Accountant	Musokantanda	+243812671054
Mr Tshipola Mumba	Civil society	Musokantanda	+243828288267
Mr Fulgence Mutolo	Pastor	Musokantanda	+243822424859
Mr Gustave Kasongo	Mabende	Musokantanda	+243810725327
Mr Kasanza Kwakana Kwaka	Chef secteur Lufupa	Musokantanda	+243818615544
Mr Mpoyo Kuny	Physician	Musokantanda	+243810007543

8.2 Photographs – Public meetings – Musokantanda

8.3 Summary

A total of 10 observations and questions were recorded during the meeting. The main comments were:

- Duration of storage of wet waste in the basin;
- Management of tailings storage facility at Kamoa;
- Updates to the Lufupa Local Development Plan not yet undertaken;
- Prioritizing the Kansoko Mine rather than Kakula for concerns of restarting feasibility studies and delaying the exploitation that everyone expects; and
- Lack of involvement of civil society in the accomplishment of the social works of Kamoa.

9.0 PUBLIC CONSULTATION – SECTEUR LUILU

9.1 Photographs – Public Consultations – SECTEUR LUILU

9.2 Summary

A total of 19 observations and questions were recorded during the meeting. The main comments relate to the following:

- Precautions taken for all persons who will be affected by the destruction of their property due to the construction of the road.

- Kamoa should take safety measures for pedestrians and other road users.
- Suggestion to write a letter to the head of sector in case of hiring, him in turn, will be able to distribute to the different grouping chiefs.
- Involve all the competent services of the State for the study where the road will be directed.
- Achievements of Community Support Projects.
- That the new road to build has no barrier because it will be a symbol of unification of several chiefdoms and villages.
- Will Kamoa co-finance the paving of the Kolwezi-Manga Manga part to Solwezi?

10.0 PUBLIC CONSULTATIONS – MUVUNDA

10.1 Photographs – Public Consultations – Muvunda.

10.2 Summary

There was no comment on the posters presented, the most comments were related to complaints including the failure to fulfill all the chief's grievances before the opening ceremony of the mine box cut. Muvunda insisted that if Kamoa Copper SA does not meet his expectations and requests, he will not attend the opening ceremony of Kakula, he even threatened to go to Kakula mine and do some ceremonies in order to call the ancestors as for the disappearance of copper in the area.

11.0 PUBLIC CONSULTATIONS – MUSOMPO

11.1 Attendance Register

The following stakeholders have attended the public consultation at Musompo on October 7, 2016.

Table 6: Attendance register – Public Consultations – Musompo

Name	Organization	Address	Telephone
Mr Isala Kazembe	Worker	Musompo	+243823354059
Mr Mwanza Tresor	Worker	Musompo	+243850386842
Mr Kasongo Mumba	Worker	Musompo	-
Mr Katshinga Patient	Unemployed	Musompo	-
Mr Lwashi Yav	Unemployed	Musompo	-
Mrs Nambi Kasongo	Unemployed	Musompo	-
Mrs Kaj Sompo	Unemployed	Musompo	-
Mrs Julie	Unemployed	Musompo	-
Mrs Mwadi Syvie	Unemployed	Musompo	-
Mrs Mujinga Mutombo	Unemployed	Musompo	-
Mrs Nyemba Tshakunima	Unemployed	Musompo	-
Mr Malambu Sany	Professor	Musompo	+243976270001
Mr Mulowayi Mukindi	Student	Musompo	+243971821179
Mr Musas Wakutshil	Secretary to the youth parliament of Lualaba Province	Musompo	+243970936796
Mr Mwanza Minda Kafwaya	Chief of land	Musompo	+243821369637
Mr Beya David	Chef Manga Manga	Musompo	-
Mr Kantumoya Georges Muteba	Teacher	Musompo	+243818072779
Mr Kyembe Kabwita Fabrice	motorcyclist	Musompo	+243997494416
Mr Kyembe Justin	Head of Square Musompo	Musompo	+243817474836
Mr Katond Isala	Head of square Manga Manga	Musompo	+243816277963
Mr Felix Kakwata Beya	Secretary	Musompo	-
Mr Muteba Mari kiloko Jean	Chief Advisor to Manga Manga chief	Musompo	-
Mr Yav Willy	Farmer	Musompo	+243975432829
Mrs Kashala Melany	Farmer	Musompo	-
Mrs Kashala Melanie	Farmer	Musompo	-
Mr Lenge wa Lenge	Farmer	Musompo	+243812341051
Mr Tshipoya Nguza Didier	Teacher	Musompo	+243815386988
Mr Nduwa Mukazu Gaston	Teacher	Musompo	+243825792062

Name	Organization	Address	Telephone
Mr Katoka Mukanda Pierre	Teacher	Musompo	+243817739103
Mr Ilunga Ngoy Foudre	Student	Musompo	+243820233069
Mr Tshipanza Alphonse	Farmer	Musompo	-
Mr Mwamba Mulenga	Teacher	Musompo	+243842747737
Mr Kasongo Tshababa	Creuseur	Musompo	+243816182736
Mr Muteba David	Farmer	Musompo	-
Mr Ilunga Freddy	Farmer	Musompo	+243823316960
Mr Koji Tshinyemba	Farmer	Musompo	-
Mr Luwenge Majila	Farmer	Musompo	-
Mr Kabange Ilunga	Farmer	Musompo	-
Mr Mumba Lusamba	Chef de village Lusamba	Musompo	-
Mr Ngoie Felix	Chef d'etablissement	Musompo	+243813626802
Mr Ilunga Pascaline	Farmer	Musompo	-
Mr Mujinga Keke	Farmer	Musompo	-
Mr Makonga Toto	Teacher	Musompo	+243810762966
Mr Lufungula Venance	Macon	Musompo	+243826171691
Mr Tshilenge Augustin	Farmer	Musompo	+243850925503
Mr Misanu Mponyo	Administrator of Territoiry of Mutshatsha	Musompo	+243813336512
Mr Tshisolo Antoine	Local police	Musompo	-
Mr Ilunga Kasongo	Local police	Musompo	-
Mr Mumba Mujinga	Farmer	Musompo	-
Mr Kasongo Isala	Farmer	Musompo	-
Mr Kayombo Ndeke	Farmer	Musompo	-
Mr Kabwita Mutombo	Farmer	Musompo	-
Mr Samie Kawama	Farmer	Musompo	-
Mr Herve Mambwe	Farmer	Musompo	-
Mr Kamona Omba	Farmer	Musompo	-
Mr Inance Kalenga	Farmer	Musompo	-
Mrs Anto Kembe	Farmer	Musompo	-
Mrs Irene Mahongo	Farmer	Musompo	-
Mrs Marie Paul Kibambe	Farmer	Musompo	-
Mrs Claire Kazadi	Farmer	Musompo	-
Mrs Claire Mukayi	Farmer	Musompo	-
Mrs Yvette Kasongo	Farmer	Musompo	
Mr Christophe Muteba	Farmer	Musompo	
Mr Kasongo Tshijika	Farmer	Musompo	
Mr Kamona Isaac	Farmer	Musompo	
Mr Patient Musenge	Farmer	Musompo	
Mr Prudent Bukasa	Farmer	Musompo	

Name	Organization	Address	Telephone
Mr Kazembe Isala	Farmer	Musompo	
Mr Mukaza Muzaila	Farmer	Musompo	
Mr Papi Muba	Farmer	Musompo	
Mr Fody Lungenda	Farmer	Musompo	
Mr Malanga Beya	Farmer	Musompo	
Mr Kasula Lucien	Farmer	Musompo	
Mr Daniel Lweyala	Farmer	Musompo	
Mr Kalumbu Yang	Farmer	Musompo	
Mr Musalo Mbumba	Chef de localite MUSALO	Musompo	
Mrs Masengo Mamie	Chef de localite Tshabula	Musompo	
Mr Kayombo Jean	Chef de localite Tshizuza	Musompo	
Mr Mukunda Lumbwe	Secretary of the Musompo	Musompo	+243821036402
Mr Kipoi Mwanza	Farmer	Musompo	+243844317728
Mr Kubulu Kasongo	Advisor to Musompo chief	Musompo	+243824232135
Mr Musompo Mukanda	Chief of land	Musompo	-
Mr Joseph Sukari	Farmer	Musompo	-
Mr Ilunga Kajila	Farmer	Musompo	-
Mr Kapokoso Grace	Farmer	Musompo	-
Mr Kabamba Monga	Farmer	Musompo	-
Mr Mwanza Kapatsh	Farmer	Musompo	-
Mr Kamwanya Kibwidi	Farmer	Musompo	-
Mr Mutunda Edouard	Farmer	Musompo	-
Mr Mumba Kayanda	Farmer	Musompo	-
Mr Tshala Tshisola	Farmer	Musompo	-
Mr Mumba Emile	Farmer	Musompo	-
Mr Tshmwasu John	Farmer	Musompo	-

11.2 Photographs – Public Consultations – Musompo

11.3 Summary

A total of 13 comments and questions were recorded during the meeting. The main comments are as follows:

- The use of local jobs opportunity such as (signalers, guards, etc.) along the route to be tracked.
- Community compensation for all villages that will be impacted by the road.
- Can the populations assumed to be affected by the road, continue their field work or stop until the road is developed.
- Request that the traditional chiefs should accompany the team that will conduct related environmental studies on the ground.
- Request that the traditional chiefs also benefit in terms of compensation as the work will be done in their land.
- Request that Kamoa should have more consideration to local communities especially when compensating those who will be affected by the road.

12.0 PUBLIC CONSULTATIONS – CITE MASEKA

12.1 Photographs – Consultations – Cite Maseka – 07 October 2016

12.2 Summary

A total of 11 comments and questions were recorded during the meeting. The main comments are as follows:

- Fear of dust on flora and fauna when Kamoa will start mining.
- Lack of school and health center at Kamisange.
- Support in agriculture.
- The animals on the Kansoko area have disappeared because of the noise.
- Kamoa to assist local communities with husbandry projects
- People are concerned as the construction project of the Kamisange school was suspended.
- Request made so that Kamoa could consider the planting of citrus nurseries in the communities
- Local communities need drinking water be supplied in the community of Cité Maseka.

13.0 PUBLIC CONSULTATIONS – KYAMADINGI

13.1 Photographs – Public Consultations - Kyamadingi




13.2 Summary

A total of 9 comments and questions were recorded during the meeting. The main comments are as follows:

- People express need to relocate the surrounding communities around the two mines.
- Local communities would like the tailings dam to be located far from the Rivers.
- Community members are concerned about dust and vibration at Kaya village.
- Most of the participants want to know the community benefits to surrounding communities of Kakula and Kamoa mines.
- Various stakeholders would like the construction of a school at Mwilu.

14.0 PUBLIC CONSULTATIONS – MUNDJENDJE

14.1 Photographs – Public Consultations – Mundjendje

14.2 Summary

A total of 11 observations and questions were recorded during the meeting. The main comments are as follows:

- People would like the erection of speed bumps and other traffic signs along community roads.
- Local communities are concerned of speeding of Kamoa cars in the local villages, lots of complaints already made on this issue but not resolved yet.
- Community members are concerned of dust in the communities causing disease.
- Local stakeholders think that the roads within the village is being destructed by Kamoa vehicles and its subcontractors.
- Some participants would like water pipes feeding water tanks at Israel village be repaired as soon as possible since they were destroyed by Kamoa mine.

GOLDER ASSOCIATES DRC SARL

Serge Kayembe
Stakeholder Engagement Specialist

Nyundo Armitage
Senior Environmental Consultant

sk/na

Reg. No. RCCM 14/-B-1561
Managers: RGM Heath, G Michau

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APPENDIX A

Stakeholders database

STAKEHOLDER ENGAGEMENT DATABASE

Table 7: Stakeholder Engagement database of the Kamoa EIS

Name	Organization	Address	Telephone
Mr Richard Muyej	Gouvernor of the Lualaba Province	Kolwezi	-
Mr Ngoie Kazadi	Coordinator of the Environment	Kolwezi	+243813845291
Mr Mashata Kayembe	Chief of staff, Provincial Department of Mines	Kolwezi	+243997124795
Mrs Muhaila Pitshi	Advisor to the Governor of Lualaba	Kolwezi	+243997016907
Mr Kapenda wa Kapenda	Assistant to the Governor	Kolwezi	-
Mr Mwilu Kashiki wa Bulongo	Chef de Groupement Mwilu	Mwilu	+243995218411
Mr Kabotwe Munena	Chef Konga	Mwilu	-
Mr Kabwita Masengo	Chef Ntunga	Mwilu	-
Mr Kibale John	Chef Walemba	Mwilu	+243995868355
Mr Mambwe Mwanza	Chef Kyamadingi	Mwilu	-
Mr Mwema Kifunga	Chef Kangalele	Mwilu	-
Mr Ilunga Kisafu	Farmer	Mwilu	+243974693820
Mr Kabutue Kasongo	Farmer	Mwilu	-
Mr Mumba Ilunga	Farmer	Mwilu	-
Mr Mitonga Maloba	Farmer	Mwilu	-
Mr Kanamina Kabunda	Farmer	Mwilu	+243898066346
Mr Mwepu Kabotwe	Farmer	Mwilu	+243994215838
Mr Ilunga Kawanda	Farmer	Mwilu	+243994241333
Mr Ilunga Kisama	Farmer	Mwilu	+243995728274
Mr Kaumba Lipengo	Farmer	Mwilu	-
Mr Kibalasa Kipanda	Farmer	Mwilu	-
Mr Mumba Gaspard	Farmer	Mwilu	-
Mr Ngoie Muke	Farmer	Mwilu	+243976656763
Mr Muvunda Kakoshi	Chief of land	Muvunda	-
Mr Kalemba Kyembe Kijiba	Notable	Muvunda	-
Mr Numbi Omba	Notable	Muvunda	-
Mr Yav Katshunga	Notable	Muvunda	-
Mr Misanu Mponyo	Administrator of the Territory of Mutshatsha	Mutshatsha	+243813336512 , + 243977780479
Mr Kabwita Beya	Accountant	Musokantanda	+243812671054
Mr Tshipola Mumba	Civil society	Musokantanda	+243828288267
Mr Fulgence Mutolo	Pastor	Musokantanda	+243822424859
Mr Gustave Kasongo	Mabende	Musokantanda	+243810725327
Mr Kasanza Kwakana Kwaka	Chef secteur Lufupa	Musokantanda	+243818615544
Mr Mpoyo Kuny	Physician	Musokantanda	+243810007543

Name	Organization	Address	Telephone
Mr Tsimba Mbabu	-	Kolwezi	+243998620379
Mr Ungana Kahilu	Pastor	Kolwezi	+243817702736
Mr Mikombe Kasongo	Physician	Kolwezi	+243810207711
Mr Ilunga Kazembe	-	Kolwezi	+243995220063
Mr Musapana Kabamba	Social Services at Kolwezi	Kolwezi	+243817446377
Mr Kumba Tshibwete	SICOMINES employee	Kolwezi	+243995272896
Mr Muzenga Mwema	Planning Department	Kolwezi	+243997029720
Mr Kowa Kyungu	Studiant	Kolwezi	+243999521393
Mr Tshiku Kamb	Studiant	Kolwezi	+24397734364
Mr Ngoie Mwana Tambwe	Studiant	Kolwezi	+243990535577
Mr Ilunga Kayembe	Herais manager	Kolwezi	+243994593175 / +243811613270
Mr Tshinyeta Kasongo	Head of Agricultural Department - Kolwezi	Kolwezi	+243997030754
Mr Munung Mwatshond	Head of Geology and Mines of Kolwezi	Kolwezi	+243970063819
Mr Wadiese Kitwa	Civil Engineer	Kolwezi	+243970318089
Mr Malambu Sany	Professor	Kolwezi	+243976270001
Mr Kayombo Mbumba	Culture and Arts	Kolwezi	+243990333468
Mr Mufuk Riy	Head of urban and rural development	Kolwezi	+243991064700
Mr Ngombe Wanshimba	Legal representative of convention des eglises pentecotistes afrique mission (C.E.P.A.M)	Kolwezi	+2439982311627
Mr Kazadi Katshinda	Reliant Congo employee	Kolwezi	+243811850642
Mr Banza Mwape	Lawyer	Kolwezi	+243997108265
Mr Kata Lukunga	Association of Farmers (Maendeleo)	Kolwezi	+243812605964
Mr Kamana Tshipulenu	Head of Gender department	Kolwezi	+243992528534
Mrs Ann Gallen	Kampi ya Boma	Kolwezi	+243818320452
Mr Mwinkeu A Kawey	Student	Kolwezi	+243975666702
Mr Kyundu Kazonda	Engineer	Kolwezi	+243993671017
Mrs Tshingwe Kaj	Presidente of l'Association for the women development" Mama ni Mama"	Kolwezi	+243813496761
Mr Kapenda Lemesa Pegle	Association des Farmers Maendeleo	Kolwezi	+243819512340
Mr Mbweti Ilunga	Farmer	Kolwezi	+243811697150
Mr Musas Wakutshiz Joseph	Student	Kolwezi	+243970936796
Mr Kayij Kayemb Freddy	Student	Kolwezi	+243979511100

Name	Organization	Address	Telephone
Mr Bukasa Tshibanda Aubin	-	Kolwezi	+243993687215
Mr Ngoie Mbidi	Agent Rulco	Kolwezi	+2439700295771
Mr Kamweni Sakauta	Student	Kolwezi	+243815401415
Mr Lenge Shalom	-	Kolwezi	+243999505058
Mr Tshibumbu Kabashi	Farmer	Kolwezi	+243851625977
Mr Elijah Mwamba	Entrepreneur	Kolwezi	+243997823939
Mr Kayenge Numbi	-	Kolwezi	+243993303659
Mr Ilunga Kashala	Computer scientist	Kolwezi	+243990378001
Mr Kabashi Naweji	Businessman	Kolwezi	-
Mr Mayiyi Kema herve	-	Kolwezi	-
Mr Muyumba Mbiana	Electricien	Kolwezi	+243993993004
Mr Muleyi Mwamba	Student	Kolwezi	+243995411099
Mr Yumbu Lukuba	Department of Environnement	Kolwezi	+243813806808
Mr Kabulo Numbi	-	Kolwezi	-
Dr Masonj Mulelemu	Provincial health department	Kolwezi	+243810179874
Mrs Kamango Mpanga Esther	-	Kolwezi	+243816160808
Mr Ilunga Ngoy Serge	Engineer - mechanic	Kolwezi	+243814385577
Maitre Kitwa Daudet	ADDH NGO	Kolwezi	+243997025716 daudetkitwa@yahoo.fr
Mr Tshaz Mwaku	-	Kolwezi	-
Mr Tshimbalanga Kabamba	Student	Kolwezi	+243821982058 - +243995860070
Mr Mugho Walumbu	-	Kolwezi	+243995888164 - +243811769597
Mr Ngoja Mambo	Teacher	Kolwezi	+243970186414 - +243858573278
Dr Mako Bakajika	Physician	Kolwezi	+243814650797 +243991474863
Mr Ngoy Bikunga	-	Kolwezi	+243993304360 +243815026959
Mr Ngoie Kabuya	Police commander of Mines and hydrocarbons – Lualaba Province	Kolwezi	+243997147881 +243814746960
Mr Kasongo Kilumba	Computer scientist	Kolwezi	+243979522333
Mr Muzala Kakoma	ADDH NGO	Kolwezi	+243995044449 +243816835524
Mr Djata Kilongo	Farmer	Kyamandingi	-
Mr Mumba Kasongo	Farmer	Kyamadingi	-
Mr Mujinga Treji	Farmer	Kyamadingi	-
Mrs Kayinda Fidelie	Farmer	Kyamadingi	-
Mrs Omba Kasongo	Farmer	Kyamadingi	-

Name	Organization	Address	Telephone
Mr Kazumba Watumaka	Farmer	Kyamadingi	-
Mrs Kaj Muteba	Farmer	Kyamadingi	-
Mrs Evrina Lengalela	Farmer	Kyamadingi	-
Mrs Asa Tshikaba	Farmer	Kyamadingi	-
Mrs Passy Kasongo	Farmer	Kyamadingi	-
Mrs Mwilu Bulongo	Farmer	Kyamadingi	-
Mrs Jeanne Kaindu	Farmer	Kyamadingi	-
Mrs Christine Kapela	Farmer	Kyamadingi	-
Mrs Esther Ilunga	Farmer	Kyamadingi	-
Mr Mwilu Mayeba	Farmer	Kyamadingi	-
Mr Makonga Mukenga	Farmer	Kyamadingi	-
Mrs Christine Kapela	Farmer	Kyamadingi	-
Mrs Esther Ilunga	Farmer	Kyamadingi	-
Mr Mwilu Mayeba	Farmer	Kyamadingi	-
Mrs Ilunga Kanyimbu	Farmer	Kyamadingi	-
Mrs Falonne Makuzo	Farmer	Kyamadingi	-
Mrs Jeanette Daimuna	Farmer	Kyamadingi	-
Mr Kashala Muzala	Farmer	Kyamadingi	-
Mr Ilunga Mujinga	Farmer	Kyamadingi	-
Mr Hitohika Kashala	Farmer	Kyamadingi	-
Mrs Vimba Dorcas	Farmer	Kyamadingi	-
Mrs Songe Ngoie	Farmer	Kyamadingi	-
Mrs Kila Lukodi	Farmer	Kyamadingi	
Mr Mawita Muteba	Farmer	Kyamadingi	-
Mr Masaku Kaseya	Farmer	Kyamadingi	-
Chef Kyamadingi Mambwe	Head of land	Kyamadingi	+243991137631
Mr Freddy Mambwe	Notable	Kyamadingi	+243978537682
Mr Ilunga Delphin	Notable of the village	Kyamadingi	+243816725599
Mr Laurent Kafwana	Nurse	Kyamadingi	+243970634294
Mr Dieudonne Mujinga	Farmer	Kyamadingi	-
Mr Ndua Mutombo	Farmer	Kyamadingi	-
Mr Daniel Katshala	Farmer	Kyamadingi	
Mr Tshimuka Tshikamo	Farmer	Kyamadingi	+243819518314
Mr Gustave Tongwa	Farmer	Kyamadingi	-
Mr Athana Monana	Mechanic	Kyamadingi	-
Mr Dominic Lumingo	Farmer	Kyamadingi	-
Mr Kakunda Kawangu	Farmer	Kyamadingi	-
Mr Tshimwasu Mbuya	Farmer	Kyamadingi	-
Mr Kabaj Tshitem	Farmer	Kyamadingi	-
Mr Moise Kazadi	Farmer	Kyamadingi	-
Mr Isonga Faustin	Farmer	Kyamadingi	+243991583815
Mr Guy Mupenda	Farmer	Kyamadingi	-

Name	Organization	Address	Telephone
Mr Kazadi Kalala	Farmer	Kyamadingi	-
Mrs Kaji Irosa Marie	Farmer	Kyamadingi	-
Mrs Ngoie Mambwe	Farmer	Kyamadingi	-
Mr Ngoie Tshinyemba Maritshi	Farmer	Kyamadingi	-
Mr Biahi Kalala	Farmer	Kyamadingi	-
Mr Ilunga Kazadi	Farmer	Kyamadingi	-
Mr Mukemba Mwamba	Farmer	Kyamadingi	-
Mr Somo Sarikicha	Farmer	Kyamadingi	-
Mr Kaumba Musokola	Farmer	Kyamadingi	+243825163758
Mr Mwema Mwanza	Farmer	Kyamadingi	-
Mr Mutombo	Farmer	Kyamadingi	-
Mr Mambwe wa Mambwe	Farmer	Kyamadingi	+243825437182
Mr Kasongo Dieudo	Farmer	Kyamadingi	-
Mr Mwanza David	Farmer	Kyamadingi	+2439084566874
Mr Sony Mushima	Farmer	Kyamadingi	-
Mr Konga Malekani	Farmer	Kyamadingi	+243821579024
Mr Tshipema Zakaria	Farmer	Kyamadingi	+243816474188
Mr Tshinyama sununu	Farmer	Kyamadingi	+243902596755
Mr Lumbwe Mahini	Farmer	Kyamadingi	-
Mr Mambwe Kakuta	Farmer	Kyamadingi	-
Mr Mujinga Michel	Farmer	Kyamadingi	-
Mr Mwanza Nyembo	Farmer	Kyamadingi	-
Mr Kasongo Kayembe	Farmer	Kyamadingi	+243999467425
Mr Ngambo Mbuya	Farmer	Kyamadingi	-
Mr Kabuya K	Farmer	Kyamadingi	-
Mr Panga Mwilu	Farmer	Kyamadingi	-
Mr Kakuta Mwilu	Farmer	Kyamadingi	-
Mr Mumba Kazend	Farmer	Kyamadingi	-
Mr Kapya Kakupa	Farmer	Kyamadingi	-
Mr Sakaro Tshimgambo	Farmer	Kyamadingi	-
Mr Mbuya Kipambi	Farmer	Kyamadingi	-
Mr Kapenda Nduwa	Farmer	Kyamadingi	-
Mr Tshakwe	Farmer	Kyamadingi	-
Mr Ilunga Muteba	Farmer	Kyamadingi	-
Mrs Lumbwe Kisala Kainda	Farmer	Kyamadingi	-
Mr Ungano Kahilu	Farmer	Kyamadingi	+243817702736
Mr Kambutwa Kapya	Farmer	Kyamadingi	+243820598920
Mr Malemba Katana	Farmer	Kyamadingi	+243822558611
Mr Tshibamba Tshishikuwa	Farmer	Kyamadingi	+243822349389

Name	Organization	Address	Telephone
Mr Yav Muzala	Farmer	Kyamadingi	+243822807833
Mr Mwanza Pierre	Farmer	Kyamadingi	+243994830756
Mr Andeli Musumari	Farmer	Kyamadingi	-
Mr Yuma Louvy	Farmer	Kyamadingi	-
Mr Yuda Star	Farmer	Kyamadingi	-
Mr Ilunga Yav	Farmer	Kyamadingi	-
Mr Kisumpa Kampompe	Farmer	Kyamadingi	-
Mr Tshinyama Njamba	Farmer	Kyamadingi	-
Mr Kaponda Lucien	Farmer	Kyamadingi	-
Mr Kapepa Benoit	Farmer	Kyamadingi	-
Mr Mwilu Kituo	Farmer	Kyamadingi	-
Mr Mbuya Makanza	Farmer	Kyamadingi	+243816763110
Mr Katshonga Mbav	Farmer	Kyamadingi	-
Mr Kamwengo Guyonne	Farmer	Kyamadingi	-
Mr Ilunga Mukanda	Farmer	Kyamadingi	-
Mr Ngoy Mutombo	Farmer	Kyamadingi	-
Mr Paulin Kasongo	Farmer	Kyamadingi	-
Mr Selemani John	Farmer	Kyamadingi	-
Mr Ilunga Koti	Farmer	Kyamadingi	-
Mr Venance Denga	Farmer	Kyamadingi	-
Mr Kalula Alphonse	Farmer	Kyamadingi	-
Mr Kahilu Kamweni	Farmer	Kyamadingi	-
Mr Kafana Mujinga	Farmer	Kyamadingi	-
Mr Kambeya Kalamba	Farmer	Kyamadingi	-
Mr Mambwe Mumba	Farmer	Kyamadingi	-
Mrs Mary Kasongo	Farmer	Kyamadingi	-
Mrs Soni Madeleine	Farmer	Kyamadingi	-
Mrs Mutombo Wivine	Farmer	Kyamadingi	-
Mr Ilunga Kasongo	Farmer	Kyamadingi	-
Mrs Kasongo Angele	Farmer	Kyamadingi	-
Mr Tshimanga Christina	Farmer	Kyamadingi	-
Mrs Tshinyama Anny	Farmer	Kyamadingi	-
Mrs Yvonne Tshitula	Farmer	Kyamadingi	-
Mrs Luciano Zembedeo	Farmer	Kyamadingi	-
Mr Kakoma Mutemba	Farmer	Kyamadingi	-
Mr Amosi Kalenda	Farmer	Kyamadingi	-
Mr Faustin Kambele	Farmer	Kyamadingi	-
Mr Mwema Kambele	Farmer	Kyamadingi	-
Mr Kabwebwe Daniel	Farmer	Kyamadingi	-
Mr Mukwita Parick	Farmer	Kyamadingi	-
Mr Sompo Sylvain	Head of square	Kyamadingi	-
Mr Mwanza Panga	Farmer	Kyamadingi	-

Name	Organization	Address	Telephone
Mr Tshiseke Christ	Farmer	Kyamadingi	-
Mr Mwilu Kaponda	Farmer	Kyamadingi	-
Mr Kaji wa Makiwa	Farmer	Kyamadingi	-
Mr Kakay Mb	Farmer	Kyamadingi	-
Mr Ilunga Mbekoma	Farmer	Kyamadingi	-
Mr Tshiwisha	Kamoa head of square	Kyamadingi	-
Mr Kayembe N.	Farmer	Kyamadingi	-
Mr Mukusa Mupenda	Farmer	Kyamadingi	-
Mr Malanda Mukonde	Farmer	Kyamadingi	-
Mr Kafutshi Mafu	Farmer	Kyamadingi	-
Mr Vinace Ki	Farmer	Kyamadingi	-
Mr Kanyembo Venance	Head of square	Kyamadingi	-
Mr Ngonga Gustave	Farmer	Kyamadingi	-
Mr Petro	Head of square	Kyamadingi	-
Mr Kabwita Muleka	Farmer	Kyamadingi	-
Mr Kayombo Tshilefu	Farmer	Kyamadingi	-
Mr Kona Kanama	Farmer	Kyamadingi	-
Mr Kananda Maloba	Farmer	Mundjendje	-
Mr Imana Jean Marie	Farmer	Mundjendje	-
Mr Mayonde Fernand	Farmer	Mundjendje	-
Mr Kaumba Saloka	Farmer	Mundjendje	-
Mr Kainda Kakwema	Farmer	Mundjendje	-
Mr Mutombo Kawangu	Farmer	Mundjendje	-
Mr Panga Katanga	Farmer	Mundjendje	-
Mr Robert Muzala	Farmer	Mundjendje	-
Mr Katayi Amede	Farmer	Mundjendje	-
Mr Kamela Baudouin	Farmer	Mundjendje	-
Mrs Chantal Kapenda	Farmer	Mundjendje	-
Mr Tshimwishi Atanance	Farmer	Mundjendje	-
Mr Tshipola Kona	Farmer	Mundjendje	-
Mr Kipepe Inas	Farmer	Mundjendje	-
Mr Simon Francois	Farmer	Mundjendje	-
Mr Katolo Andre	Farmer	Mundjendje	-
Mrs Namusaya Malale	Farmer	Mundjendje	-
Mr Tshanga Mwanza	Farmer	Mundjendje	-
Mr Katuka Kapuba	Farmer	Mundjendje	-
Mr Kapya Ilunga	Farmer	Mundjendje	-
Mr Malose Samulomba	Farmer	Mundjendje	-
Mr Samulomba Kambaji	Farmer	Mundjendje	-
Mr Ramice Kaumba	Farmer	Mundjendje	-
Mr Muke Mweka	Farmer	Mundjendje	-
Mr Kayimana Masatshi	Farmer	Mundjendje	-

Name	Organization	Address	Telephone
Mrs Betty Yemba	Farmer	Mundjendje	-
Mrs Mujinga Fany	Farmer	Mundjendje	-
Mr Saitamba Kanema	Farmer	Mundjendje	-
Mr Shamalenge Kaluswika	Farmer	Mundjendje	-
Mrs Folo Tontoka	Farmer	Mundjendje	-
Mr Kayembe Mushilu Jean Luc	Farmer	Mundjendje	-
Mr Patrick Kawanga Mwelwa	Farmer	Mundjendje	-
Mrs Lisette Robby	Farmer	Mundjendje	-
Mr Mumba Bonny	Farmer	Mundjendje	-
Mrs Ernestine Nelly	Farmer	Mundjendje	-
Mr Mujinga Nyota	Farmer	Mundjendje	-
Mr Tshikuta Mujinga Tresor	Farmer	Mundjendje	-
Mr Mahamba Omba	Farmer	Mundjendje	-
Mr Kanyimbu Kasongo	Farmer	Mundjendje	-
Mr Kila Kasongo	Farmer	Mundjendje	-
Mrs Annie Marie	Farmer	Mundjendje	-
Mrs Beya Kainda	Farmer	Mundjendje	-
Mr Kamuya Katayi	Farmer	Mundjendje	-
Mr Munika Katumba	Farmer	Mundjendje	-
Mr Kema Nandjolomba	Farmer	Mundjendje	+243828456120
Mr Ilunga Tshikwama	Farmer	Mundjendje	+243819729277
Mr Ndanda Tongolongo	Farmer	Mundjendje	+243829578816
Mr Kenefi Katala	Farmer	Mundjendje	-
Mr Kalenga Yono	Farmer	Mundjendje	-
Mr Tambwe Mumba	Farmer	Mundjendje	-
Mr Kasongo Shamalenge	Farmer	Mundjendje	-
Mr Mutombo Kalenge	Farmer	Mundjendje	-
Mr Masengo Andre	Farmer	Mundjendje	-
Mr Kasongo Mudimbe Mdiye	Farmer	Mundjendje	-
Mr Kabutwa Stany	Farmer	Mundjendje	-
Mr Kapalo Tshiyungu	Farmer	Mundjendje	-
Mr Delemi Wa Kapenda	Farmer	Mundjendje	-
Mr Kalenga Mukunji	Farmer	Mundjendje	-
Mr Mahiji Malengo	Farmer	Mundjendje	-
Mrs Kabeya Tshibola	Farmer	Mundjendje	-
Mr Kazimir Katala	Farmer	Mundjendje	-
Mr Kayembo Imbe Imbe	Farmer	Mundjendje	-
Tshisola Alexis	Farmer	Mundjendje	-

Name	Organization	Address	Telephone
Mr Kakeza Hibert	Farmer	Mundjendje	-
Mr Kaumba Samuel	Farmer	Mundjendje	-
Mr Mwamba wa Mulu	Farmer	Mundjendje	-
Mr Lusanga Ngoie	Farmer	Mundjendje	-
Mr Naweji Namutoka	Farmer	Mundjendje	-
Mr Ilunga Dimbewa	Farmer	Mundjendje	-
Mr Ilunga Kimba	Farmer	Mundjendje	-
Mr Tshilombo Mandela	Farmer	Mundjendje	-
Mr Kalenga Kyembe	Farmer	Mundjendje	-
Mr Kajimana Kabwita	Farmer	Mundjendje	-
Mr Mujinga Naweji	Farmer	Mundjendje	-
Mr Mwenda Yav	Farmer	Mundjendje	-
Mr Kuwema Mbavu Felix	Farmer	Mundjendje	-
Mr Ilunga wa Ilunga	Farmer	Mundjendje	-
Mr Mubola Makembo	Farmer	Mundjendje	-
Mr Katan Kojan	Farmer	Mundjendje	-
Mr Senga Victor	Farmer	Mundjendje	-
Mr Tshinyemba Mandefu	Farmer	Mundjendje	-
Mr Baraka Mafanda	Farmer	Mundjendje	-
Mr Kiteka Muyembe	Farmer	Mundjendje	-
Mr Kasongo Gaston	Farmer	Mundjendje	-
Mr Ngweji Mukosai	Farmer	Mundjendje	-
Mr Mbuyi Tshibumbu	Farmer	Mundjendje	-
Mr Sakaote Augustin	Farmer	Mundjendje	-
Mr Omba Musapana	Farmer	Mundjendje	-
Mr David Katshitau	Farmer	Mundjendje	-
Mr Steven Banza	Farmer	Mundjendje	-
Mr Katolo Modeste	Farmer	Mundjendje	-
Mrs Louise Kaloko	Farmer	Mundjendje	-
Mrs Kainda Annie	Farmer	Mundjendje	-
Mrs Eliane Banza	Farmer	Mundjendje	-
Mr Mbav Sambond	Farmer	Mundjendje	-
Mr Ifuka Matthieu	Farmer	Mundjendje	-
Mr Mutute Sylvain	Farmer	Mundjendje	-
Mr Mukaz Tshiyuka	Farmer	Mundjendje	-
Mr Kayembe Augustin	Farmer	Mundjendje	-
Mr Prince Kasaji	Farmer	Mundjendje	-
Mr Mwanza Kyembe Costa	Farmer	Mundjendje	-
Mr David Tshitau	Farmer	Mundjendje	-
Mr Kaponda Kolanga	Chef Kaponda	Mundjendje	-
Mr Ndumba Tshinyemgu Moise	Farmer	Mundjendje	-

Name	Organization	Address	Telephone
Mr Malandji Remy	Farmer	Mundjendje	-
Mr Kasongo Raphael	Farmer	Mundjendje	-
Mr Kaj Theodore	Farmer	Mundjendje	-
Mr Kakisa Paulin	Farmer	Mundjendje	-
Mr Kaumba Mujinga	Farmer	Mundjendje	-
Mr Mwanza Michel	Farmer	Mundjendje	-
Mr Kasongo Ilunga	Farmer	Mundjendje	-
Mr Yav Kavula	Farmer	Mundjendje	-
Mr Ngoie Luka	Farmer	Mundjendje	-
Mr Kwaja Kendre	Farmer	Mundjendje	-
Mr Kanyembo Tshikwama Gael	Farmer	Mundjendje	+243814042853
Mr Oswu Mpanga	Farmer	Mundjendje	-
Mr Mukoji Kalwaji	Farmer	Mundjendje	-
Mr Mahamba Patient	Farmer	Mundjendje	-
Mr Kadjata Tshikwama	Farmer	Mundjendje	-
Mr Kanyembo David	Farmer	Mundjendje	-
Mr Kazadi Willy	Farmer	Mundjendje	-
Mr Masudi Kanyembo	Farmer	Mundjendje	-
Mr Kazadi Alain	Farmer	Mundjendje	-
Mr Kasongo Justin	Farmer	Mundjendje	-
Mr Yava Ilunga	Farmer	Mundjendje	-
Mr Ngombe Lumbwe	Farmer	Mundjendje	-
Mr Ilunga Kasongo	Farmer	Mundjendje	-
Mr Ilunga Kasongo	Farmer	Mundjendje	-
Mr Kaj Tshikwama	Farmer	Mundjendje	-
Mr Kawangu Tshinyama	Farmer	Mundjendje	-
Mr Kazadi Muyembe	Farmer	Mundjendje	-
Mr Naweji Mazanga	Farmer	Mundjendje	-
Mr Kazembe Kavula	Farmer	Mundjendje	-
Mr Tshibambi Kintu	Farmer	Mundjendje	-
Mr Kanyimbu John	Farmer	Mundjendje	-
Mr Gregoire Mudidi	Farmer	Mundjendje	-
Mr Kasongo Alphonse	Farmer	Mundjendje	-
Mr Kanyembo Ilunga	Farmer	Mundjendje	-
Mr Pezulu Damas	Farmer	Mundjendje	-
Mr Kabwita Alain	Farmer	Mundjendje	-
Mr Konge Moise	Farmer	Mundjendje	-
Mr Mahuma Honore	Farmer	Mundjendje	-
Mr Masoji Muzala	Farmer	Mundjendje	-
Mr Kasono Leon	Farmer	Mundjendje	-
Mrs Nyota Rebecca	Farmer	Mundjendje	-
Mr Katende Tamar	Farmer	Mundjendje	-

Name	Organization	Address	Telephone
Mr Kahinda Melanie	Farmer	Mundjendje	-
Mrs Mwanza Justine	Farmer	Mundjendje	-
Mrs Kazadi Nicole	Farmer	Mundjendje	-
Mr Mpanga Swana	Farmer	Mundjendje	-
Mrs Tshisola Marthe	Farmer	Mundjendje	-
Mr Nuna Malaika	Farmer	Mundjendje	-
Mrs Omba Suzanne	Farmer	Mundjendje	-
Mrs Matemba Raigaine	Farmer	Mundjendje	-
Mr Mudimbewa Gerard	Farmer	Mundjendje	-
Mr Kabunda Tresor	Farmer	Mundjendje	-
Mr Mbayo Sengi	Farmer	Mundjendje	-
Mr Junior Louis	Farmer	Mundjendje	-
Mr Sony Moise	Farmer	Mundjendje	-
Mr Katala Heritier	Farmer	Mundjendje	-
Mr Kalungisha Joseph	Farmer	Mundjendje	-
Mr Songomba Masengo	Farmer	Mundjendje	-
Mr Mumba Cedrick	Farmer	Mundjendje	-
Mr Kazadi Kayombo	Farmer	Mundjendje	-
Mr Shamalenge Ralwisika	Farmer	Mundjendje	-
Mr Kalumbu Theophile	Farmer	Cite Maseka	+243822537607
Mr Tshifataka Kayombo	Farmer	Cite Maseka	+243824762697
Mr Tshilenge Kabinda	Farmer	Cite Maseka	+243825200860
Mr Musanji Kaumba	Farmer	Cite Maseka	-
Mr Tshipoya Gustave	Farmer	Cite Maseka	-
Mr Samuwaka Tshipoya	Farmer	Cite Maseka	+24381715215
Mr Kayembe Kikanda	Farmer	Cite Maseka	-
Mr Amon Manyonga	Farmer	Cite Maseka	-
Mr Alex Mbaya	Farmer	Cite Maseka	-
Mr Kabinda Kayembe	Farmer	Cite Maseka	-
Mr Kayembe Kikanda	Farmer	Cite Maseka	-
Mr Tumba Kambamba	Farmer	Cite Maseka	-
Mr Kiteka Kalimoya	Farmer	Cite Maseka	-
Mr Kailu Malemba	Farmer	Cite Maseka	-
Mr Danzama Delphin	Farmer	Cite Maseka	-
Mr Kalongo Kalumbu	Student	Cite Maseka	-
Mr Fiston Kabinda	Farmer	Cite Maseka	-
Mr Samuwika Willy	Farmer	Cite Maseka	-
Mrs Estha Koni	Farmer	Cite Maseka	-
Mr Tabita Yuni	Farmer	Cite Maseka	-
Mr Luthi Kalumbu	Farmer	Cite Maseka	-
Mrs Mbuyi Anna	Farmer	Cite Maseka	-
Mrs Evrina Mujinga	Farmer	Cite Maseka	-

Name	Organization	Address	Telephone
Mr Patin Mulemba	Farmer	Cite Maseka	-
Mrs Isa Katuntu	Farmer	Cite Maseka	-
Mrs Mujinga Solange	Farmer	Cite Maseka	-
Mr Moloza David	Farmer	Cite Maseka	-
Mr Ehilu Koji	Farmer	Cite Maseka	-
Mr Mwanza Matemba	Farmer	Cite Maseka	-
Mr Kasango Ilunga	Farmer	Cite Maseka	-
Mr Mekizito Kazadi	Farmer	Cite Maseka	-
Mr Mukinda Namasola	Farmer	Cite Maseka	-
Mr Chizawu Chire	Head of square	Cite Maseka	-
Mrs Kafuta Evelyne	Farmer	Cite Maseka	-
Mr Kayombo Samba	Farmer	Cite Maseka	-
Mr Kakunda Panga	Farmer	Cite Maseka	-
Kazuk Lwaze	Farmer	Cite Maseka	-
Mr Banga Katanga	Farmer	Cite Maseka	-
Mr Mwibwe Banze	Farmer	Cite Maseka	-
Mr Lumbwe Kalala	Farmer	Cite Maseka	-
Mr Mukima Francoise	Farmer	Cite Maseka	-
Mr Yowanu Ngudinsone	Macon	Cite Maseka	-
Mr Ikungu Selengi	Farmer	Cite Maseka	-
Mrs Kayinda Dishare	Farmer	Cite Maseka	-
Mr Ikombo Joseph	Farmer	Cite Maseka	-
Mr Moise Tshiposa	Farmer	Cite Maseka	-
Mr Tiyofili Merani	Farmer	Cite Maseka	-
Mr Kapalu Mumba	Farmer	Cite Maseka	-
Mr Ilunga Kawango	Farmer	Cite Maseka	-
Mr Moleka Mpanga	Farmer	Cite Maseka	-
Mr Kaba Sitina	Farmer	Cite Maseka	-
Mr Ilunga Katambo	Farmer	Cite Maseka	-
Mrs Kamina Antoinette	Farmer	Cite Maseka	-
Mr Kafaya Ansi	Farmer	Cite Maseka	-
Mrs Bijou Kalonga	Farmer	Cite Maseka	-
Mrs Viviane Kapila	Farmer	Cite Maseka	-
Mr Mununga Kawangu	Farmer	Cite Maseka	-
Mr Kasongo Tshababa	Farmer	Cite Maseka	-
Mr Doussam Kalumbu	Infirmier	Cite Maseka	-
Mr Kayinda wa mukola	Head of the locality	Cite Maseka	-
Mr Kasongo Joseph	Farmer	Cite Maseka	-
Mr Ngombe Mpanga	Farmer	Cite Maseka	-
Mr Mbangu Mwanda	Farmer	Cite Maseka	-
Mr Mufunta Kalumbu	Farmer	Cite Maseka	-
Mr Shimishi Daniel	Farmer	Cite Maseka	-

Name	Organization	Address	Telephone
Mr Bonheur Mupila	Farmer	Cite Maseka	-
Mr Kasongo Matemba	Farmer	Cite Maseka	-
Mr Kanema Lukama	Farmer	Cite Maseka	-
Mr Kalenga Augustin	Farmer	Cite Maseka	-
Mr Kalumbu Mandela	Farmer	Cite Maseka	-
Mr Kasongo na Ndongo	Farmer	Cite Maseka	-
Mr Mulawo Mpanga	Farmer	Cite Maseka	-
Mr Mwidya Selemani	Farmer	Cite Maseka	-
Mr Ndumba Katema	-	Cite Maseka	-
Mr Katolo Kanene	Jardinier	Cite Maseka	-
Mrs Miwiti Mireille	Housewife	Cite Maseka	-
Mrs Benidy Ariette	Housewife	Cite Maseka	-
Mrs Tshilombo Mujinga	Farmer	Cite Maseka	-
Mrs Chantale Kalumbu	Student	Cite Maseka	-
Mrs Modestine Ralene	Housewife	Cite Maseka	-
Mr Kasongo Colette	Housewife	Cite Maseka	-
Mrs Makaji Tantine	Farmer	Cite Maseka	-
Mrs Tshikomba Kanyembo	Housewife	Cite Maseka	-
Mrs Kafweko Kahuma	Housewife	Cite Maseka	-
Mrs Kayumba Assi	Housewife	Cite Maseka	-
Mrs Kapalu Mujinga	Housewife	Cite Maseka	-
Mrs Kayumba Assi	Student	Cite Maseka	-
Mrs Kapalu Mujinga	Housewife	Cite Maseka	-
Mrs Kasongo Mpanga	Housewife	Cite Maseka	-
Mrs Mutombo Kapenda	Housewife	Cite Maseka	-
Mrs Ndona Albertine	Farmer	Cite Maseka	-
Mr Sompo Kapila	Farmer	Cite Maseka	-
Mrs Marie Womba	Housewife	Cite Maseka	-
Mr Kalumbu Sakaleji	Farmer	Cite Maseka	-
Mrs Sahara Mujinga	Housewife	Cite Maseka	-
Mrs Wivine Sariya	Farmer	Cite Maseka	-
Mrs Kapenda Fatuma	Housewife	Cite Maseka	-
Mr Kalumbu Kalongo	Housewife	Cite Maseka	-
Mrs Sara Ado	Housewife	Cite Maseka	-
Mrs Kalumbu Doussam	Student	Cite Maseka	-
Mr Isala Kazembe	Worker	Musompo	+243823354059
Mr Mwanza Tresor	Worker	Musompo	+243850386842
Mr Kasongo Mumba	Worker	Musompo	-
Mr Katshinga Patient	Unemployed	Musompo	-
Mr Lwashi Yav	Unemployed	Musompo	-
Mrs Nambi Kasongo	Unemployed	Musompo	-
Mrs Kaj Sompo	Unemployed	Musompo	-

Name	Organization	Address	Telephone
Mrs Julie	Unemployed	Musompo	-
Mrs Mwadi Syvie	Unemployed	Musompo	-
Mrs Mujinga Mutombo	Unemployed	Musompo	-
Mrs Nyemba Tshakunima	Unemployed	Musompo	-
Mr Malambu Sany	Professor	Musompo	+243976270001
Mr Mulowayi Mukindi	Student	Musompo	+243971821179
Mr Musas Wakutshil	Secretary to the youth parliament of Lualaba Province	Musompo	+243970936796
Mr Mwanza Minda Kafwaya	Chief of land	Musompo	+243821369637
Mr Beya David	Chef Manga Manga	Musompo	-
Mr Kantumoya Georges Muteba	Teacher	Musompo	+243818072779
Mr Kyembe Kabwita Fabrice	Motocyclist	Musompo	+243997494416
Mr Kyembe Justin	Head of Musompo area	Musompo	+243817474836
Mr Katond Isala	Head of Manga Manga area	Musompo	+243816277963
Mr Felix Kakwata Beya	Secretary	Musompo	-
Mr Muteba Mari kiloko Jean	First Advisor to Manga Manga chief	Musompo	-
Mr Yav Willy	Farmer	Musompo	+243975432829
Mrs Kashala Melany	Farmer	Musompo	-
Mrs Kashala Melanie	Farmer	Musompo	-
Mr Lenge wa Lenge	Farmer	Musompo	+243812341051
Mr Tshipoya Nguza Didier	Teacher	Musompo	+243815386988
Mr Nduwa Mukazu Gaston	Teacher	Musompo	+243825792062
Mr Katoka Mukanda Pierre	Teacher	Musompo	+243817739103
Mr Ilunga Ngoy Foudre	Student	Musompo	+243820233069
Mr Tshipanza Alphonse	Farmer	Musompo	-
Mr Mwamba Mulenga	Teacher	Musompo	+243842747737
Mr Kasongo Tshababa	Artisanal miner	Musompo	+243816182736
Mr Muteba David	Farmer	Musompo	-
Mr Ilunga Freddy	Farmer	Musompo	+243823316960
Mr Koji Tshinyemba	Farmer	Musompo	-
Mr Luwenge Majila	Farmer	Musompo	-
Mr Kabange Ilunga	Farmer	Musompo	-
Mr Mumba Lusamba	Head of Lusamba village	Musompo	-
Mr Ngoie Felix	School master	Musompo	+243813626802
Mr Ilunga Pascaline	Farmer	Musompo	-
Mr Mujinga Keke	Farmer	Musompo	-

Name	Organization	Address	Telephone
Mr Makonga Toto	Teacher	Musompo	+243810762966
Mr Lufungula Venance	Macon	Musompo	+243826171691
Mr Tshilenge Augustin	Farmer	Musompo	+243850925503
Mr Misanu Mponyo	Administrator of the Territory of Mutshatsha	Musompo	+243813336512
Mr Tshisolo Antoine	Local police	Musompo	-
Mr Ilunga Kasongo	Local police	Musompo	-
Mr Mumba Mujinga	Farmer	Musompo	-
Mr Kasongo Isala	Farmer	Musompo	-
Mr Kayombo Ndeke	Farmer	Musompo	-
Mr Kabwita Mutombo	Farmer	Musompo	-
Mr Samie Kawama	Farmer	Musompo	-
Mr Herve Mambwe	Farmer	Musompo	-
Mr Kamona Omba	Farmer	Musompo	-
Mr Inance Kalenga	Farmer	Musompo	-
Mrs Anto Kembe	Farmer	Musompo	-
Mrs Irene Mahongo	Farmer	Musompo	-
Mrs Marie Paul Kibambe	Farmer	Musompo	-
Mrs Claire Kazadi	Farmer	Musompo	-
Mrs Claire Mukayi	Farmer	Musompo	-
Mrs Yvette Kasongo	Farmer	Musompo	
Mr Christophe Muteba	Farmer	Musompo	
Mr Kasongo Tshijika	Farmer	Musompo	
Mr Kamona Isaac	Farmer	Musompo	
Mr Patient Musenge	Farmer	Musompo	
Mr Prudent Bukasa	Farmer	Musompo	
Mr Kazembe Isala	Farmer	Musompo	
Mr Mukaza Muzaila	Farmer	Musompo	
Mr Papi Muba	Farmer	Musompo	
Mr Fody Lungenda	Farmer	Musompo	
Mr Malanga Beya	Farmer	Musompo	
Mr Kasula Lucien	Farmer	Musompo	

Name	Organization	Address	Telephone
Mr Daniel Lweyala	Farmer	Musompo	
Mr Kalumbu Yang	Farmer	Musompo	
Mr Musalo Mbumba	MUSALO head of locality	Musompo	
Mrs Masengo Mamie	Tshabula head of locality	Musompo	
Mr Kayombo Jean	Tshizuza head of locality	Musompo	
Mr Mukunda Lumbwe	Musompo secretary	Musompo	+243821036402
Mr Kipoi Mwanza	Farmer	Musompo	+243844317728
Mr Kubulu Kasongo	Advisor to Musompo chief	Musompo	+243824232135
Mr Musompo Mukanda	Chief of land	Musompo	-
Mr Joseph Sukari	Farmer	Musompo	-
Mr Ilunga Kajila	Farmer	Musompo	-
Mr Kapokoso Grace	Farmer	Musompo	-
Mr Kabamba Monga	Farmer	Musompo	-
Mr Mwanza Kapatsh	Farmer	Musompo	-
Mr Kamwanya Kibwidi	Farmer	Musompo	-
Mr Mutunda Edouard	Farmer	Musompo	-
Mr Mumba Kayanda	Farmer	Musompo	-
Mr Tshala Tshisola	Farmer	Musompo	-
Mr Mumba Emile	Farmer	Musompo	-
Mr Tshmwasu John	Farmer	Musompo	-
Mr Masengo Kabwita	Farmer	Mwilu	+243995283378
Mr Mbuy Kasongo	Farmer	Mwilu	-
Mr Kabutwa Mwepu	Farmer	Mwilu	-
Mr Kibanda Wa Mumba	Farmer	Mwilu	-
Mr Ilunga Sephano	Farmer	Mwilu	-
Mr Kayindu Katalo	Farmer	Mwilu	-
Mr Kisafa Ngombe	Farmer	Mwilu	-
Mr Ngoie Kipasha	Farmer	Mwilu	-
Mr Leji Joseph	Farmer	Mwilu	-

Name	Organization	Address	Telephone
Mr Mutwala Augustin	Farmer	Mwilu	-
Mr Mumba Kwanda Costantin	Farmer	Mwilu	-
Mr Mao Kidiata	Farmer	Mwilu	-
Mr Katonga Kaseya	Farmer	Mwilu	-
Mr Mununga Casimir	Farmer	Mwilu	-
Mr Kyembe Kambimbi	Farmer	Mwilu	-
Mr Mwilu Kabanda	Farmer	Mwilu	-
Mr Kapia Kafula	Farmer	Mwilu	-
Mr Kasongo Kafula	Farmer	Mwilu	-
Mr Kongolo Karita	Farmer	Mwilu	-
Mr Lukungwa Kyabene	Farmer	Mwilu	-
Mr Kizedi Mukubu	Farmer	Mwilu	-
Mr Lukanga Kahinda	Farmer	Mwilu	-
Mr Kasongo Ilunga	Farmer	Mwilu	+243995521840
Mr Kakonka Pampa	Farmer	Mwilu	-
Mr Mitole Bulungu	Farmer	Mwilu	-
Mr Mpanga Kashiki	Farmer	Mwilu	-

APPENDIX B

Document limitations

DOCUMENT LIMITATIONS

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GOLDER ASSOCIATES AFRICA (PTY) LTD

APPENDIX C

Exploitation Certificate

KAMOA COPPER SA
UNE FILIALE DE IVANHOE MINES
Société Anonyme
(Avec Conseil d'Administration)

1148-6, Avenue De la Libération, Quartier Golf Les Battants
Commune de Lubumbashi, Ville de Lubumbashi
Province du Katanga, République Démocratique du Congo
www.ivanhoemines.com

Kinshasa, le 09 Mai 2016

BIAC BANQUE INTERNATIONALE POUR L'AFRIQUE AU CON
S.A.
SERVICE COURRIER
Reçu le : 09 MAY 2016
Par :
Heure :

N/Réf.: KAMCO SA /LN-LKW/025/0905/2016

A la Banque Internationale
pour l'Afrique au Congo SA
01, Avenue de la Douane
Immeuble NIOKI
Kinshasa/Gombe
Att. Part. Mme le Directeur Général

Madame le Directeur Général,

Concerne : **Demande de cautionnement de la 3ème tranche de la sureté financière des Permis d'Exploitation n°12873, 13025 et 13026**

Nous venons par la présente solliciter le cautionnement de la Banque d'un montant de 153.000,00 USD, relativement à la 3ème tranche de la sureté financière des Permis d'Exploitation mieux identifiés en concerne, et ce, aux mêmes termes et conditions que la deuxième tranche précédente, dont nous joignons la copie pour votre convenance.

Espérant que la Banque continuera à nous accompagnera pour respecter cette obligation légale, veuillez agréer, Madame le Directeur Général, l'assurance de ma parfaite considération.

Louis K. WATUM
Directeur Général

Banque Internationale pour l'Afrique au Congo

ACTE DE CAUTIONNEMENT N° 0030/2015

La s, **BANQUE INTERNATIONALE POUR L'AFRIQUE AU CONGO "B.I.A.C."**, ci-après dénommée « LA CAUTION» dont le siège social est à Kinshasa, agissant par les soussignés en vertu des pouvoirs à eux régulièrement conférés, déclare par le présent acte se constituer caution solidaire et indivisible envers et au profit de la **Direction de Protection de l'Environnement Minier**, jusqu'à concurrence de **USD.122.181,- (Dollars américains cent vingt deux mille cent quatre-vingt-un)** correspondant à la libération de la première tranche relative à la sureté financière dur les Permis d'exploitation numéros 12873,13025 et 13026 dont **KAMOA COPPER SA** , dont le siège est situé à Lubumbashi au numéro 1148-6, Quartier Golf les Battants Avenue de la Libération, commune de Lubumbashi, ci-après dénommée « **LE CAUTIONNE** », est ou pourrait devenir redevable au **Ministère des Mines/ Direction de Protection de l'Environnement Minier**, en application de l'annexe II du règlement minier en vigueur relative à la Directive sur la Sureté financière de Réhabilitation de l'Environnement Minier.

Tous les montants garantis en vertu du présent acte sont ceux résultant des lois et réglementations précitées, actuellement en vigueur. Ces montants restent aussi garantis par le présent acte si les opérations précitées sont accomplies après modification officielle de leurs conditions d'application.

La caution en cette qualité et sous renonciation formelle aux bénéfices de division et de discussion, s'oblige au paiement des montants ci-dessus mentionnés, et ce dans les trente jours de la réception du jugement que lui enverrai le tribunal territorialement compétent.

Le paiement serait à effectuer au crédit du compte ouvert par la **Direction de Protection de l'Environnement Minier** auprès de la banque Centrale du Congo ou dans toute autre banque désignée dans la sommation.

La caution se réserve le droit de résilier son engagement moyennant préavis de nonante (90) jours notifié au **Ministère des Mines/ Direction de Protection de l'Environnement Minier** cité dans l'acte. Elle est libérée de ses engagements si la **Direction de Protection de l'Environnement Minier** n'introduit aucun recours avant l'expiration du préavis. Le préavis doit parvenir aux destinataires par lettre recommandée.

Le présent acte de cautionnement est valable jusqu'à la présentation par **KAMOA COPPER SA** d'une Attestation de la libération des obligations environnementales en rapport avec les travaux d'exploitation minière couverts par les permis de recherches numéros 12873,13025 et 13026. En outre, la caution se réserve le droit de se libérer avant terme par la constitution d'un cautionnement en espèces.

N.B.: - Seul l'original portant le cachet de la Banque l'engage au titre de caution.
- La présente garantie expire au plus tard le 19 août 2042.

Kinshasa, le 15 juin 2015

Aubin LUBASU
Fondé de Pouvoirs

Iyane DIA
Directeur des Risques

B.I.A.C. [illegible] B.P. 8725 Kinshasa 1 (R.D. Congo)
Tél. : +243 (0)81 555 40 [illegible] Site web : www.biac.cd Swift (BIC) : BIACCDKI
Clientele Corporate [illegible] Banque Privee [illegible] Courriel : private@biac.cd
PME : Tél. [illegible] Particuliers [illegible] particuliers@biac.cd
Western Union : Tél. [illegible]

KAMOA COPPER SA
UNE FILIALE DE IVANHOE MINES
Société Anonyme
(Avec Conseil d'Administration)

1148-6, Avenue De la Libération, Quartier Golf Les Battants
Commune de Lubumbashi, Ville de Lubumbashi
Province du Katanga, République Démocratique du Congo
www.ivanhoemines.com

Kinshasa, le 25 Mars 2015

N/Réf.: KAMCO SA/GN/022/0325/2015

S.A.
SERVICE COURRIER
30 MARS 2015

A la bonne attention de :

Monsieur l'Administrateur Directeur Général
De la Banque Internationale
pour l'Afrique au Congo (« BIAC »)
De et à Kinshasa/Gombe

Monsieur l'Administrateur Directeur Général,

Concerne : Demande de constitution de cautionnement pour la sûreté financière 2015 des Permis d'Exploitation n°12873,13025 et 13026

Nous venons par la présente solliciter la constitution d'un cautionnement bancaire en vos livres pour notre compte d'une somme de **91.360,00 USD** (Nonante et un Mille Trois-cent soixante Dollars Américains) pour l'année 2015 en plus de celui de l'ordre de **30.821,00 USD** (Trente Mille Huit -cent Vingt et Un Dollars Américains) constitué pour l'année 2014 en guise de la sûreté financière de réhabilitation de l'environnement qui est une obligation légale pour tout titulaire des Droits miniers afin de garantir l'accomplissement de ses obligations environnementales pendant son activité de recherches ou d 'exploitation.

En effet, la constitution d'une sûreté financière étant une obligation légale, nous avions opté pour la caution conformément, à l'article 7 de l'annexe II du Règlement Minier portant directive sur la sûreté financière de réhabilitation de l'environnement.
C'est pourquoi, nous aimerions que la BIAC, dont nous sommes Cliente, se porte caution de nos obligations à hauteur de la somme susmentionnées.
Nous sommes disponibles pour discuter des conditions avec vos services et nous vous saurions gré de transmettre les actes originaux y relatifs à nos bureaux de Kinshasa afin de faciliter le processus.

Espérant que cette requête retiendra votre particulière attention et que vous y accorderez le bénéfice de l'urgence, veuillez agréer, Monsieur l'Administrateur Directeur Général, l'assurance de notre parfaite considération.

Guy NZURU SOLO
Administrateur

REPUBLIQUE DEMOCRATIQUE DU CONGO

CADASTRE MINIER

CERTIFICAT D'EXPLOITATION

N°CAMI/CE/6639/12.

En exécution de l'Arrêté Ministériel n° **0540/CAB.MIN/MINES/01/2012** du **20/08/2012** portant octroi du **PERMIS D'EXPLOITATION** n° **13026** , au nom de **AFRICAN MINERALS (Barbados) Ltd Sprl** ayant son siège social sis **Boulevard Kamanyola, n°2548, Lubumbashi, Katanga,**

Est établi le présent **CERTIFICAT D'EXPLOITATION** qui lui confère le droit exclusif d'effectuer, du **20/08/2012** au **19/08/2042**, les travaux de recherches, de développement et d'exploitation des substances minérales suivantes : **Argent, Bismuth, Cadmium, Cobalt, Cuivre, Fer, Germanium, Nickel, Or, Palladium, Platine, Plomb, Rhenium, Soufre et Zinc**, à l'intérieur du périmètre faisant l'objet du **PERMIS D'EXPLOITATION** composé de **202** carrés situés dans le Territoire de **Mutshatsha**, District de **Kolwezi**, Province de **Katanga**.

Les coordonnées géographiques des sommets dudit périmètre sont reprises dans l'Annexe **1** qui fait partie intégrante du présent **CERTIFICAT**.

Délivré à Kinshasa, le 21 AUG 2012

DIRECTEUR GENERAL

Jean-Félix MUPANDE KAPWA

Mentions Spécifiques

- Il est rappelé au titulaire de ce titre minier qu'en application de l'article 592 du Règlement Minier, il est tenu de respecter les dispositions du Chapitre VI du Titre XVIII dudit Règlement visant la mise en conformité environnementale des opérations exécutées en vertu de son PERMIS D'EXPLOITATION.
- Il est également rappelé le dépôt de l'Attestation de Commencement des travaux de développement et de construction dans les **3 ans** de la délivrance du titre.
- Toute modification ultérieure du présent CERTIFICAT D'EXPLOITATION sera, selon le cas, portée au dos de ce titre ou reprise dans une des annexes complémentaires qui en feront parties intégrantes.

REPUBLIQUE DEMOCRATIQUE DU CONGO
CADASTRE MINIER

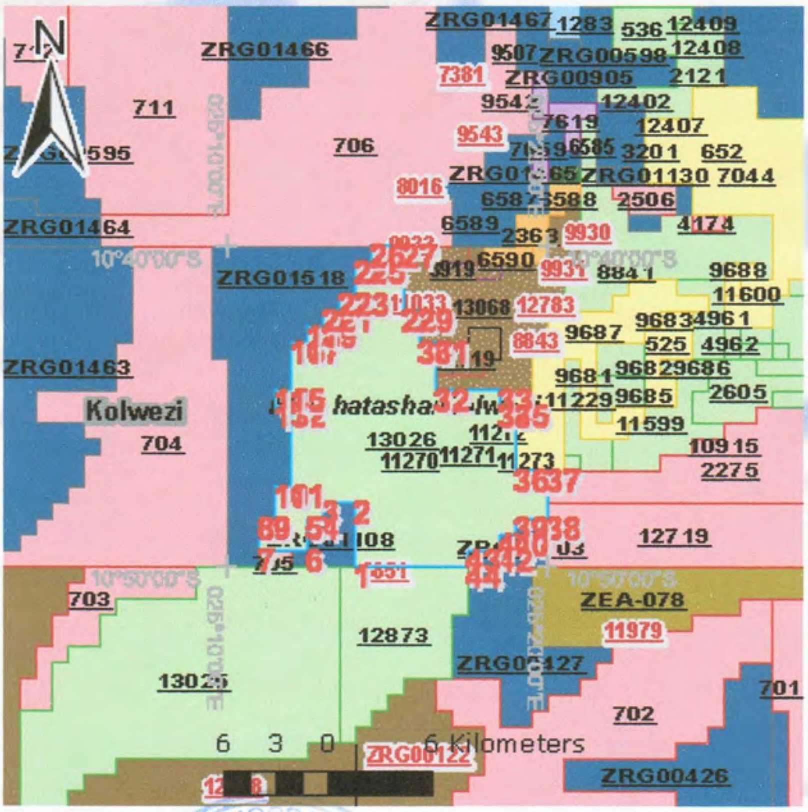
Téléphone: **015 162618**
Facsimile:
Email: info@cami.cd
Website: **www.cami.cd**

DIRECTION GENERALE
Croisement des Avenues Mpolo Maurice et
Kasa-Vubu, GOMBE
BP 7987, Kin 1
KINSHASA

EXTRAIT DE LA CARTE DE RETOMBE MINIERE

Titre	**13026**
Type	**Permis d'Exploitation**
Titulaire	**AFRICAN MINERALS (Barbados) Ltd Sprl**
Localisation	**Katanga, Kolwezi, Mutshatsha**

Annexe 1



Cartes de Retombe	**S11/25**	Nombre de carrés	**202**
Datum	**WGS84**	Date d'Octroi	**20/08/2012**
Projection	**UTM**	Date de fin de validité	**19/08/2042**

REPUBLIQUE DEMOCRATIQUE DU CONGO
CADASTRE MINIER

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Website: **www.cami.cd**

DIRECTION GENERALE
Croisement des Avenues Mpolo Maurice et
Kasa-Vubu, GOMBE
BP 7987, Kin 1
KINSHASA

LISTE DES COORDONNEES GEOGRAPHIQUES

Titre **13026**

Type **Permis d'Exploitation**

Titulaire **AFRICAN MINERALS (Barbados) Ltd Sprl**

Localisation **Katanga, Kolwezi, Mutshatsha**

Annexe 1

	Longitude			Latitude		
Sommets	**Deg**	**Min**	**Sec**	**Deg**	**Min**	**Sec**
1	25	14	00.00	- 10	50	00.00
2	25	14	00.00	- 10	48	00.00
3	25	13	00.00	- 10	48	00.00
4	25	13	00.00	- 10	48	30.00
5	25	12	30.00	- 10	48	30.00
6	25	12	30.00	- 10	49	30.00
7	25	11	00.00	- 10	49	30.00
8	25	11	00.00	- 10	48	30.00
9	25	11	30.00	- 10	48	30.00
10	25	11	30.00	- 10	47	30.00
11	25	12	00.00	- 10	47	30.00
12	25	12	00.00	- 10	45	00.00
13	25	11	30.00	- 10	45	00.00
14	25	11	30.00	- 10	44	30.00
15	25	12	00.00	- 10	44	30.00
16	25	12	00.00	- 10	43	00.00
17	25	12	30.00	- 10	43	00.00
18	25	12	30.00	- 10	42	30.00
19	25	13	00.00	- 10	42	30.00
20	25	13	00.00	- 10	42	00.00
21	25	13	30.00	- 10	42	00.00
22	25	13	30.00	- 10	41	30.00
23	25	14	00.00	- 10	41	30.00
24	25	14	00.00	- 10	40	30.00
25	25	14	30.00	- 10	40	30.00
26	25	14	30.00	- 10	40	00.00

REPUBLIQUE DEMOCRATIQUE DU CONGO
CADASTRE MINIER

27	25	15	30.00	- 10	40	00.00
28	25	15	30.00	- 10	42	00.00
29	25	16	00.00	- 10	42	00.00
30	25	16	00.00	- 10	43	00.00
31	25	16	30.00	- 10	43	00.00
32	25	16	30.00	- 10	44	30.00
33	25	18	30.00	- 10	44	30.00
34	25	18	30.00	- 10	45	00.00
35	25	19	00.00	- 10	45	00.00
36	25	19	00.00	- 10	47	00.00
37	25	20	00.00	- 10	47	00.00
38	25	20	00.00	- 10	48	30.00
39	25	19	00.00	- 10	48	30.00
40	25	19	00.00	- 10	49	00.00
41	25	18	30.00	- 10	49	00.00
42	25	18	30.00	- 10	49	30.00
43	25	17	30.00	- 10	49	30.00
44	25	17	30.00	- 10	50	00.00

Cartes de Retombe **S11/25** Nombre de carrés **202**

Datum **WGS84** Date d'Octroi **20/08/2012**

Projection **UTM** Date de fin de validité **19/08/2042**

REPUBLIQUE DEMOCRATIQUE DU CONGO
CAMI
CADASTRE MINIER

République Démocratique du Congo

MINISTERE DES MINES

Le Ministre

ARRETE MINISTERIEL N° 0540/CAB.MIN/MINES/01/2012 DU 20 AOUT 2012.
PORTANT OCTROI DU PERMIS D'EXPLOITATION
N° 13026 A LA SOCIETE AFRICAN MINERALS (BARBADOS SPRL)

Vu la Constitution, telle que modifiée et complétée à ce jour, spécialement ses articles 93, 202 point 36 littera f et 203 point 16 ;

Vu la Loi n° 007/2002 du 11 juillet 2002 portant Code Minier, spécialement ses articles 10, 12, 43,47 et 69 à 72 ;

Vu le Décret n° 038/2003 du 26 mars 2003 portant Règlement Minier, notamment ses articles 145, à 150 ;

Vu l'Ordonnance n° 12/007 du 11 juin 2012 portant organisation et fonctionnement du Gouvernement, modalités pratiques de collaboration entre le Président de la République, et le Gouvernement ainsi qu'entre les membres du Gouvernement ;

Vu l'Ordonnance n° 12/008 du 11 juin 2012 fixant les attributions des Ministères, spécialement son article 1er B points 6 et 14 ;

Vu l'Ordonnance n° 12/004 du 28 avril 2012 portant nomination des Vice-Premiers Ministres, des Ministres, d'un Ministre Délégué et des Vice-Ministres ;

Considérant la demande de Permis d'Exploitation n° **4581** introduite par la **Société AFRICAN MINERALS (BARBADOS SPRL)** en date du **31/10/2011** et les pièces requises y jointes ;

Sur avis favorable du Cadastre Minier, de la Direction des Mines et de la Direction chargée de la protection de l'Environnement Minier ;

ARRETE :

Article 1er :

Il est octroyé à la **Société AFRICAN MINERALS (BARBADOS SPRL)**, ayant son siège social sise Boulevard Kamanyola n° 2548, à Lubumbashi/Katanga, **le Permis d'Exploitation n° 13026.**

Article 2 :

Le Permis d'Exploitation n° **13026** est établi sur un périmètre composé de **202** carrés entiers situés dans le Territoire de Mutshatshsa, District de Kolwezi, Province du **Katanga**.

Les coordonnées géographiques des sommets dudit périmètre suivant le datum WGS 84 et la projection UTM, sont :

	Longitude			Latitude		
Sommets	**Degré**	**Minute**	**Seconde**	**Degré**	**Minute**	**Seconde**
1	25	14	00.00	- 10	50	00.00
2	25	14	00.00	- 10	48	00.00
3	25	13	00.00	- 10	48	00.00
4	25	13	00.00	- 10	48	30.00
5	25	12	30.00	- 10	48	30.00
6	25	12	30.00	- 10	49	30.00
7	25	11	00.00	- 10	49	30.00
8	25	11	00.00	- 10	48	30.00
9	25	11	30.00	- 10	48	30.00
10	25	11	30.00	- 10	47	30.00
11	25	12	00.00	- 10	47	30.00
12	25	12	00.00	- 10	45	00.00
13	25	11	30.00	- 10	45	00.00
14	25	11	30.00	- 10	44	30.00
15	25	12	00.00	- 10	44	30.00
16	25	12	00.00	- 10	43	00.00
17	25	12	30.00	- 10	43	00.00
18	25	12	30.00	- 10	42	30.00
19	25	13	00.00	- 10	42	30.00
20	25	13	00.00	- 10	42	00.00
21	25	13	30.00	- 10	42	00.00
22	25	13	30.00	- 10	41	30.00
23	25	14	00.00	- 10	41	30.00
24	25	14	00.00	- 10	40	30.00
25	25	14	30.00	- 10	40	30.00
26	25	14	30.00	- 10	40	00.00
27	25	15	30.00	- 10	40	00.00
28	25	15	30.00	- 10	42	00.00
29	25	16	00.00	- 10	42	00.00

30	25	16	00.00	- 10	43	00.00
31	25	16	30.00	- 10	43	00.00
32	25	16	30.00	- 10	44	30.00
33	25	18	30.00	- 10	44	30.00
34	25	18	30.00	- 10	45	00.00
35	25	19	00.00	- 10	45	00.00
36	25	19	00.00	- 10	47	00.00
37	25	20	00.00	- 10	47	00.00
38	25	20	00.00	- 10	48	30.00
39	25	19	00.00	- 10	48	30.00
40	25	19	00.00	- 10	49	00.00
41	25	18	30.00	- 10	49	00.00
42	25	18	30.00	- 10	49	30.00
43	25	17	30.00	- 10	49	30.00
44	25	17	30.00	- 10	50	00.00

Carte de retombe : S11/25

Article 3 :

Le Permis d'Exploitation n° **13026** confère à la **Société AFRICAN MINERALS (BARBADOS Sprl)** le droit de procéder aux travaux de prospection, de Recherches et d'Exploitation des substances suivantes : **Cuivre, Cobalt, Zinc, Plomb, Argent, Or, Soufre, Fer, Platine, Palladium, Germanium, Rhénium, Nickel, Cadmium et Bismuth.**

Ce droit s'étend également à la construction des installations et infrastructures nécessaires à l'exploitation des Mines, à l'utilisation des ressources d'eau et du bois se trouvant à l'intérieur du périmètre pour les besoins de l'exploitation des mines, à la libre commercialisation des produits marchands conformément à la législation en la matière ainsi qu'a la réalisation des opérations de concentration, de traitement métallurgique ou technique et de transformation des produits extraits du gisement.

Article 4 :

Sur présentation du récépissé du paiement des droits superficiaires annuels par carrés prorata temporis, le présent Permis d'Exploitation donne lieu à la délivrance d'un Certificat d'Exploitation.

A défaut de paiement des droits superficiaires annuels par carré prorata temporis dans les trente jours ouvrables à compter de la date du présent Arrêté, le Permis d'Exploitation n° **13026** devient caduque, conformément aux prescrits de l'article 159 du Règlement Minier.

Article 5 :

Le Permis d'Exploitation n° **13026** est valable pour une durée de 30 (trente) ans, à dater de la signature du présent Arrêté.

Il pourra être renouvelé plusieurs fois pour une durée de quinze ans à chaque renouvellement.

Article 6 :

La Société AFRICAN MINERALS (BARBADOS SPRL) est notamment tenue de :

1°S'acquitter, chaque année, des droits superficiaires par carré conformément aux dispositions de l'article 198 du Code Minier et des articles 157 et 396 du Règlement Minier ;

2°Transmettre chaque semestre un relevé du registre d'extraction et chaque année, le rapport d'activités à la Direction des Mines ainsi qu'à la Division Provinciale des Mines et Géologie ou au Bureau minier du ressort, en vertu des articles 216 du Code Minier, 499 et 501 du Règlement Minier ;

3°Déposer tous les trimestres, à la Direction de Géologie ou au Bureau Minier du ressort, les échantillons prélevés au cours des travaux de recherches ainsi qu'une copie de sa carte de recherches ;

4°Fournir aux agents de la Direction des Mines et de la Direction chargée de la Protection de l'Environnement minier dûment mandatés, tous les moyens de parcourir le périmètre et d'inspecter ses travaux de recherches minières ;

5°Tenir sur le terrain, les journaux et les registres de suivi journalier des travaux de prospection, de recherches et d'exploitation, vérifiables par les agents des Directions des Mines et de Géologie pendant l'inspection ;

6°Respecter les dispositions du Chapitre VI du Titre XVIII du Règlement minier visant la mise en conformité environnementale des opérations exécutées en vertu du Permis d'Exploitation.

Article 7 :

Sans préjudice des dispositions de l'article 30 du Code Minier, il est interdit aux tiers d'entreprendre les travaux de prospection, de recherches et/ou d'exploitation à l'intérieur du périmètre couvert par le Permis d'Exploitation n° **13026.**

Article 8:

Toute violation, par le titulaire du Permis d'Exploitation n° **13026**, des dispositions du Code Minier, du Règlement Minier ou du présent Arrêté, entraîne, selon les cas définis par la législation minière et sans préjudice d'autres sanctions, la suspension des activités ou le retrait dudit Permis d'Exploitation.

Article 9 :

Le Secrétaire Général des Mines et le Directeur Général du Cadastre Minier, sont chargés, chacun en ce qui le concerne, de l'exécution du présent Arrêté qui entre en vigueur à la date de sa signature.

Fait à Kinshasa, le 20 AOUT 2012.

Martin KABWELULU

AMPLIATIONS

Cabinet du Président de la République	: 1
Cabinet du Premier Ministre	: 1
Cabinet du Ministre des Mines	: 2
Secrétariat Général des Mines	: 1
Cadastre minier	: 1
CTCPM	: 1
SAESSCAM	: 1
Direction des Mines	: 1
Direction de Géologie	: 1
Direction des Investigation	: 1
Direction chargée de la Protec. de l'Environ	: 1
Div. Prov./des Mines & Géologie du ressort	: 1
La Société **AFRICAN MINERALS (BARBADOS SPRL)**	: 1
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