TD2 New Slag Dump Project

Environmental Impact Statement

Second Draft Report
September 2014

Prepared for

Konkola Copper Mines Plc

Revision Schedule

Rev	Date	Details	Prepared by	Reviewed by	Approved by
0	July 2014	Draft for Comments	**Boston Katongo** Principal Environmental Scientist **Bulaya Chalwe** Principal Engineer	**Patrick Kampengele** Executive Director	**Patrick Kampengele** Executive Director
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Abbreviations and Acronyms

Abbreviation	Definition
CSR	Corporate Social Responsibility
ADT	Average Daily Traffic
BAT	Best Available Techniques
CMC	Chingola Municipal Council
COP	Chingola Open Pit
CSO	Central Statistics Office
CSR	Corporate Social Responsibility
DAPP	Development Aid People to People
DDCC	District Development Coordinating Committee
ECZ	Environmental Council of Zambia
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EP	Equator Principles
EPA	Environmental Protection Agency
EPF	Environmental Protection Fund
ESIA	Environmental and Social Impact Assessment
ESIS	Environmental and Social Impact Statement
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
HDI	Human Development Index
HIV/AIDS	Human Immuno Virus/Acquired Immuno Deficiency Syndrome
HSE	Health Safety and Environment
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standards
IUCN	International Union for Conservation of Nature
KCM	Konkola Copper Mine Plc
masl	metres above sea level
MDG	Millennium Development Goals
METS	Misenge Environmental and Technical Services Limited
MFEZ	Multi-Facility Economic Zone
MMDA	Mines and Minerals Development Act
MSD	Mine Safety Department
MWSC	Mulonga Water and Sewerage Company
NWASCO	National Water and Sanitation Council
PCD	Pollution Control Dam
PDI	Provincial Development Index
SHE	Safety Health and Environment
SI	Statutory Instrument
SNDP	Sixth National Development Plan
STIs	Sexually Transmitted Infections
TD	Tailings Dam
TLP	Tailings Leach Plant
TLV	Threshold Limit Value
ToR	Terms of Reference
TSF	Tailings Storage Facility
TSP	Total Suspended Solids

Abbreviation	Definition
TWA	Time-weighted Average
UNDP	United Nations Development Programme
URS SW	URS Scott Wilson
USD	United States Dollars
WD	Water Dam
ZCCM-IH	ZCCM-Investment Holdings
ZEMA	Zambia Environmental Management Agency
ZHDR	Zambia Human Development Report

Declaration of the Authenticity

We, Konkola Copper Mines Plc, the undersigned, declare that the contents of this Environmental and Social Impact Statement (ESIS) reflect the available information at the project site and within the broader project area at the time of undertaking the environmental and social impact assessment study for the proposed New Slag Dump at TD2 in Chingola.

We further declare that the conclusions drawn in this ESIS are based on conditions encountered and available information at the time of the assessment.

We acknowledge that implementation of the project will be regulated by the existing Zambian environmental legislation and other applicable legislation. The implementation of the project will also conform to applicable international guidelines and standards.

For and on behalf of Konkola Copper Mines Plc

_____

Manager Environment

Konkola Copper Mines Plc

Executive Summary

Introduction

This document presents the draft Environmental and Social Impact Statement (ESIS) for the proposed New Slag Dump Project. The ESIS document has been prepared by URS Scott Wilson on behalf of Konkola Copper Mines Plc (KCM), the project proponent.

The ESIS has been prepared in accordance with the requirements of the Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No.28 of 1997), which stipulates issues to be covered in conducting an Environmental and Social Impact Assessment (ESIA) study and the stages that must be followed. It has also been prepared in line with the requirements of Vedanta Sustainability Framework and the International Finance Corporation Policy on Environmental and Social Sustainability.

Project Background

KCM owns and operates Nchanga, Konkola, Nkana and Nampundwe mine sites in Zambia. At its Nchanga Mine Site in Chingola, KCM commissioned the Nchanga Copper Smelter to smelt copper concentrates from its own concentrators and purchased concentrates. The smelter has a design capacity of 300,000 tonnes of finished copper per year. The main products produced from the smelter are copper anodes and the waste product is granulated copper slag, which is dumped at its existing Slag Dump No. 25. An estimated 35,000 tonnes of granulated slag is generated per month, which is about 1,000 to 1,500 tonnes of slag per day.

The existing slag dump has reached its design capacity and its extension has been constrained by the existence of several physical features that include Block "A" Open Pit, Chingola Stream, Chingola - Chililabombwe Public road, KCM Haulage Road and drain.

KCM is, therefore, proposing to undertake a project to construct and operate a new Slag Dump at TD2.

Objective of the Project

The objective of the project is to dispose of granulated copper slag in a safe and environmentally friendly manner by constructing and operating a new slag dump at the reclaimed TD2 tailings storage facility situated within KCM Nchanga Mine License Area.

Estimated Project Cost

The total project cost for the eight segments of the Slag Dump stands at approximately USD 10 million. The first segment cost is USD 950,000. The overall cost for implementing environmental management and monitoring plan for the 20 years dumping life is pegged at 20% of the overall cost. This works out to be USD 2 Million. Project implementation has been planned to commence once approval of the Final ESIS has been granted by ZEMA.

Legal and Administrative Framework

This ESIS has been prepared in line with the requirements of the Zambian Environmental Management Act, 2011 and its subsidiary legislation, the Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No.28 of 1997). It also refers to the Mines and Minerals Development Act, 2008, the Mines and Minerals (Environmental) Regulations, 1997, the Ionising Radiation Protection Act, 2005, the Public Roads Act, 2002, the Road Traffic Act, 2002 and other applicable legislations and regulations. The administrative framework within which the proposed project will be implemented will include Zambia Environmental Management Agency (ZEMA), the Mine Safety Department, Radiation Protection Authority and other regulatory and government agencies.

Project implementation will also conform to international conventions and internationally recognised standards such as Equator Principles (EP). The EP are based on and implemented in accordance with

World Bank Group's International Finance Corporation (IFC) Performance Standards (PS) and the IFC Environmental Health and Safety (EHS) Guidelines. Reference will also be made to International Atomic Energy Agency and International Commission on Radiological Protection requirements for guidance on radiation protection.

This project will also be implemented within the confinement of the Vedanta Sustainability Framework, which is aligned with IFC PS.

Project Description and lifespan

The project elements will involve widening the existing access road to reclaimed TD2, construction of a drainage system around the footprint of the dump in order to direct runoff around the dump to the pollution control dam. It will also involve transportation of slag from Nchanga Smelter to TD2 Slag Dump. This will be followed by dumping of slag on site and levelling.

The proposed project is expected to have a lifespan of 20 years.

Project alternatives

The possible project alternatives that have been considered relate to the location of the Slag Dump. Site selection criteria involved taking into account three pillars of sustainable development, namely environmental, social and economic factors. The proposed project sites are situated within KCM Nchanga Mine License Area. These are Site 1 - North of OB 1, Site 2 - South of TD3 and TD4, Site 3 - Mimbula area, Site 4 - Open Pit (main in pit), and Site 5 - TD2.

The preferred site is Site No. 5 - TD2. The site is within the reclaimed TD2 tailings storage facility footprint adjacent to the Western flank of TD7 tailings storage facility, which is currently being used as an emergency tailings dam. The site is characterised by small bare anti-hills and heaps of the remaining tailings.

Environmental and Social Impact Assessment Methodology

The ESIA Methodology adopted in carrying out the environmental and social impact study is outlined in this document. It includes the approach to environmental and social impact assessment, public consultations and identification and assessment of the impacts. The potential impacts have been assessed using standard methods of assessment and terminology. The impacts have been assessed in terms of their nature, duration, intensity, probability of occurring and their overall significance.

Environmental and Social Baseline Conditions of the Project Area

Seismic Site Characterisation

The seismic site characterization of the TD2 project site revealed that crust beneath the site dips towards the north-western region of the site having low surface ground elevations and has raised lithological thicknesses on the south-eastern region where higher surface elevation values have been observed. It has further revealed that competent rock units of the north-western flanks show intrusions of deep seated faults and fractured/weathered zones as compared to the south-eastern competent rock units which have only mapped these deformations in shallow depths.

Groundwater Hydrogeology

The groundwater regime within the Nchanga Mining License Area has significantly been altered because of underground and open pit mining activities. An evaluation of the level of the water table at the TD2 project site based on the seismic refractory survey undertaken has revealed a water level in the range of approximately 15 – 40 m below the surface.

The seismic refractory survey undertaken has further revealed that the bedrock surface has a "pyramidal" like structure with a gradual slant of bedrock depths towards the north-west and steep bedrock depths

dipping towards the south-east of the project site. The entire bedrock surface shows a NNE-SSW strike. The bedrock is interpreted as relatively impermeable Late Precambrian Katanga sediments and it can be inferred that the north-west and south-east trending structure of the bedrock topography controls the shallow groundwater flow at the site.

Depth to unweathered bedrock shows a variation range of approximately 6 – 53 m below land surface at the TD2 project area.

Water Quality Assessment

Surface Water Quality

Background surface water in the Mushishima Stream (downstream of project site) and Chingola Stream (Upstream of project site) as well as in the Kafue River at Hippo Pool monitored in May 2014 indicate that water quality is generally good and is within the effluent and wastewater discharge limits provided in the Environmental Management (Licensing) Regulations, 2013. The Chingola Stream was monitored upstream close to the industrial area.

Groundwater Quality

The groundwater regime within the Nchanga Mining License Area has significantly been changed because of underground and open pit mining activities. In terms of groundwater quality, the available data generally indicates that both shallow and deeper Bedrock Aquifer groundwater quality falls within the World Health Organisation Drinking Water Standards.

The groundwater monitoring borehole nearest to the proposed project site sunk on the north-eastern side of the site has not intercepted water at a depth of 50 metres. The available data gathered from groundwater monitoring boreholes at TD3/4 that have also been reclaimed shows that quality of borehole water generally meets requirements except for the parameters Manganese, Chromium, Cadmium, Aluminium and Turbidity.

Air Quality

The main sources of emissions identified at the project site were wind-blown dust from the tailings dump and dust generated by the movement of utility vehicles along the existing access roads.

The $PM_{2.5}$, PM_{10} and TSP measurements measured in the communities around TD2 (Kamana Farm, Hellen School, Mushishima Primary School, Mulenda Dairy Farm and Police Checkpoint) are generally all in compliance with the current emissions limits for ambient air pollutants. Elevated results were recorded at Mulenda farm, which is situated at the edge of TD2. The results at Mulenda are a reflection of the levels that are obtaining very near the source, which is the reclaimed TD2 Tailings Storage Facility.

Soils and Land Use

The surface soils at the TD2 are generally covered with whitish brown fine to medium grained tailings while the subsoils are principally reddish brown, fine to coarse grained insitu material. Reddish brown, medium to coarse grained lateritic soils, and dark brown and fine grained mixture of tailings and insitu material, graduating into darkish grey insitu material, are found in some places within the proposed site.

The acidity of the soils near the existing TD2 vary from slightly acid to medium acidity while the acidity of the soils far away from the existing TD2 vary from strong to very strong acidity. The cation exchange capacities at all the sites are low indicating that the soils are of poor fertility. The soils at all the sites have also low levels of nitrogen while some have low levels of phosphorous.

With the exception of soils at Helen dump site, the soils with sand in the texture had high porosities while those without sand had either low or normal porosity. All the soils have very high water holding capacities in relation to their soil textures.

Land Use / Land Tenure

Proposed project site falls within the Nchanga Mine Surface Rights Area owned by KCM. Land use within the area is dominated by mining activities. Land use at the project site will be restricted for use as a slag disposal facility.

Other land uses within the broader project area include agricultural activities (dairy farming, livestock rearing, gardening, and maize and groundnuts cultivation) charcoal burning and illegal mining activities.

Terrestrial Flora and Fauna

The diversity of flora and fauna species within the Nchanga mining license area is poor mainly because of mining operations, human settlements, agriculture and other human activities that have resulted in loss of wildlife habitat and subsequent loss in species diversity.

Miombo is the dominant woodland around the project area, although the actual project area is mainly devoid of woody species as the site has been used as a tailings dump in the past. Dominant taxa around the project site area include *Brachystegia, Isoberlinia* and *Julbernada* with Marquesia macroura, Erythrophleum africanum and Parinari curatellifolia as frequent associates. The lower storey is mainly characterised by *Albizia antunesiana, Anisophyllea boehmii, Ochna* spp., *Pseudolachnostylis maprouneifolia* and *Syzygium guineense*.

A number of woody plant species occur around the peripheral of the project site while actual project site is predominantly of herbaceous plants namely; *Waltera indica, Pycerus polystachyos, Digitaria nemoralis, Aerva leucura* and *Rhyachne rottboellioides*. None of these species is either threated or endangered according the IUCN Red Data List.

The aquatic ecosystem has limited plant diversity and it is mainly dominated with semi-aquatic species of *Phragmites* and sedges. *Phragmites mauritianus*, commonly known as Phragmites dominates the aquatic environment of the area. A number of sedges, namely *Cyperus esculentus, C.compressus, C. Rotundus* and *C.obtusifolia* occur along the stream. All these species are common across most of the aquatic ecosystems of Southern Africa, especially along the small streams.

Terrestrial and aquatic fauna study divided fauna into mammals, reptiles and amphibians. A number of these animal groupings occur around the project site. However, the population of mammals is very low, with most of the mammals often cited as being of Least Concern according to IUCN Red List.

Archaeological or cultural heritage sites

There are no known archaeological or cultural heritage sites at the proposed site. The site has been extensively used for mining operations particularly for storage of tailings from the plant area. The tailings have since been reclaimed and reprocessed at the Tailings Leach Plant (TLP).

With the broader Chingola area, there are some known archaeological sites, such as Mushishima Stream Site, Hippo Pool Site, Chingola Garden Site, Kapisha Hot Springs and cooling towers at Nchanga Mine. . The proposed project will not affect any of these sites.

Traffic volume

Traffic volumes through Chingola Town to Solwezi and Chililabombwe and back from the same towns to Chingola have continued to increase over the past years. This is due to increased economic activities in Solwezi and Chililabombwe Districts and the North Western Province in general.

The average daily traffic (ADT) volumes from Solwezi to Chingola and from Chingola to Solwezi on T5 are estimated at 710 and 494 respectively while the ADT volumes from Chililabombwe to Chingola and from Chingola to Chililabombwe on T3 are estimated 1,162 and 1,175 respectively. 59% of vehicles on T5 were moving towards Chingola while 41% were moving towards Solwezi. Approximately an equal volume of traffic (50%) was moving on T3 towards Chililabombwe and back to Chingola.

The composition of the traffic volume shows that many of the vehicles were passenger cars and 5 axle semi-trailers. Currently the dump trucks used to haul slag from Nchanga Smelter to the existing slag dump do not cross the T3 and the T5.

Noise and vibrations

Baseline noise levels at the project site range between 64 dBA and 39 dBA with the highest levels (60 – 64 dBA) recorded near the TD2 Pump Station. Other locations further away from TD2 Pump Station recorded noise levels below the maximum ambient allowable noise levels (55 dBA) recommended for residential, institutional and educational setting. The project area is categorised as industrial. Therefore, the baseline noise levels within the project area is within the International Finance Corporation / World Bank Group maximum ambient allowable noise levels of 70 dBA recommended for industrial and commercial areas.

There were no perceptible ground vibrations at the project site at the time of the survey.

The nearest places considered as noise-sensitive and vibration-sensitive receptors in relation to the project site are Mushishima Village located about 350 metres to the south of project site and Mushishima Primary School located about 800 metres further to the south of the project site.

Radiation

The baseline surface dose rates show that the current Slag Dump at Nchanga Mine has the highest in both surface dose rates due to gamma radiation and activity due to alpha and beta particles. The surface dose rate due to gamma radiation recorded is 3.54 milli-sieverts per year (mSv/yr) while the dose rate due alpha and beta particles is 1.23 Becquerel (Bq). The proposed project site at TD2 had the second highest surface dose rates (1.59 mS/yr) due to gamma radiation and relatively high in contamination due to alpha and beta particles (0.58 Bq). .

Chingola Stream and the proposed access route had almost the same surface dose rates (1.27 mS/yr, 1.23 and mS/yr respectively) due to gamma radiation but the contamination due to alpha and beta particles was high in Chingola Stream (0.65 Bq). The lowest surface dose rates due to gamma radiation were for Mushishima Stream (0.92 mS/yr) and the lowest contamination were for the proposed access route (0.08 Bq).

Social and economic assessment

Mining activities dominates the local economy of Chingola District and the Copperbelt Province in general. It drives the local socio-economic activities of the district and contributes significantly to the local economy through employment and tax revenues to the local authority.

Agriculture in the district is generally practiced at subsistence level. The main crop grown is maize. Maize is grown both for consumption and for market. Other crops grown in the district are groundnuts.

For the local communities surrounding the proposed project site, fishing, subsistence agriculture and livestock rearing are the major livelihood activities. Sustainable Livelihoods Projects focusing on income generation, personal hygiene, sustainable livelihood and training are also being implemented by KCM in partnership with other stakeholders such as Development Aid People to People and Village Water.

The Mushishima settlement is the closest populated area to the project site. It has 100 households with an approximate population of 500 people. The settlement has no piped water. Potable water is obtained from water kiosks operated by Mulonga Water and Sewerage Company. The settlement has electricity provided by KCM. There are no sanitation facilities. The old communal washrooms and toilets are non-operational.

The New Mushishima Primary School is within the broader project area and has 245 pupils. The school runs classes from Grade 1-9. Children progressing to secondary school go to Maiteneke Secondary School, Chingola High School and the Chingola Centre for Continuing Education.

Environmental and Social Impacts and Mitigation Measures

The environmental and social impacts that could potentially arise as a result of the proposed project have been identified based on available information. For potential impacts predicted to be significant, mitigation measures have been recommended.

Water Quality

Potential Impacts

The potential impacts on surface water relate to contamination of surface water cause by release of suspended solids in surface run-off and mine drainage in nearby streams. In addition, the impacts relate to siltation of nearby rivers and streams caused by release of silt from the proposed project site into the streams. This can give rise to potential disruption of aquatic life.

The potential impacts on groundwater resources that can arise relate to contamination of groundwater caused by seepage into the groundwater regime of oil spills from construction and operations equipment, site runoff and effluent seepage from the proposed slag dump. Potential discharge of contaminated groundwater into surface streams can also result in contamination of the receiving waters.

Mitigation measures

The proposed mitigation measures to minimise surface water contamination will include the following:

- Extending and implementing the existing water monitoring plan to the proposed project;
- Routine sampling and testing of seepage and runoff from the slag dump to monitor and assess any potential contamination. Two sampling points where representative samples will be collected will be established;
- Provision of toe drain and under-drainage filters along the periphery of the dump;
- Constructing silt traps along the periphery of the dump as per design report;
- Constructing a drainage system at the TD2 dump that will channel any surface runoff and seepage from the dump into the Pollution Control Dam (PCD).

The mitigation measures to minimise potential groundwater by site runoff and seepage from the slag dump will include the following:

- Designing the slag dump with a filter under-drainage system that will collect seepage from the dump and recycle it through TLP (detailed design have been concluded);
- Installation of four groundwater monitoring boreholes around the proposed project site to monitor and assess impact of seepage on receiving water body (aquifers) and taking appropriate action.
- Implementation of the water monitoring plan for the proposed project. This will include monitoring of groundwater and all discharges from the Slag Dump (seepage and surface runoff).

Air Quality

Potential Impacts

The key potential negative impacts on air quality associated with the proposed project are dust and gaseous emissions caused by the movement of construction and operation vehicles. The dust and gaseous emissions have the potential of impairing local air quality which can affect human life, animal life, plant life and the general environment.

The positive impacts of the proposed project on local air quality is the reduction of fugitive dust emissions from exposed surfaces of the former tailings dump that will arise through covering with slag a relatively large area of exposed surface of the reclaimed TD2 tailings storage facility.

Mitigation Measures

The mitigation measures that will be undertaken to minimise dust generation, gaseous emission and workers' exposure to dust are:

- Suppression of dust from haulage road will be done by using water bowsers and/or molasses.
- Provision of appropriate personal protective equipment to workers that will be involved in site preparation and construction activities;
- Regular maintenance of haulage trucks and bulldozer to be used on site to ensure performance of the engines is at a high standard;
- Applying speed controls to reduce dust releases associated with high speed movement of mobile equipment. Speed will be limited to 40 km/hr.

Reduction in fugitive dust emissions from exposed surfaces of TD2 will be enhanced by ensuring that a large area of TD2 footprint is covered with slag material in line with the dump design footprint.

Soils and Land Use

Potential Impacts

The potential impacts on soils mainly relate to soil erosion caused by surface run from the dump and soil contamination caused by spillage of slag along the access roads and dumping of slag outside the footprint of the dump and leakages of oils and fuels from the vehicles.

Mitigation Measures

The mitigation measures to be adopted to minimise soil erosion and soil contamination will include the following:

- Constructing proper drainages and using other well-established engineering measures to control soil erosion;
- All construction and operations vehicles will be properly maintained to prevent any potential leakages of oils and fuel that can give rise to soil contamination.
- All the surface runoff and sediment load control features that will be constructed along the access road to the slag dump will be regularly inspected and maintained.
- In an event of an accidental slag spills outside the dump area, the slag will be cleaned up and deposited at the designated disposal area to minimise soil contamination;
- Developing and implementing an emergency response plan for proposed new slag dump project to manage accidental slag spills, incidents and emergencies. The development and implementation of the emergency response plan will be done in conjunction with the existing KCM Emergency Response Plan.

Flora and fauna

Potential Impacts

The potential impacts on flora and fauna during construction phase relate to loss of vegetation whose species has been assessed as being neither rare or endemic or threatened and loss of aquatic terrestrial and aquatic life arising from potential contamination of water resources.

Mitigation Measures

Terrestrial flora and fauna

The loss of vegetation due to dumping of slag on the project site will be mitigated by ensuring that dumping is restricted to the inside part of the project site. No dumping of slag around the dump peripheral should be allowed. This will ensure that the existing vegetation around the peripheral is left standing and contribute to trapping any slag particles that may be escape and contaminate the environment.

Aquatic flora and fauna

The potential for slag to be washed down into nearby streams will be minimised by the design of the drainage system at proposed slag dump which include construction of toe drains that will collect surface runoff and effluents from the dump and direct it to Tailings Leach Plant (TLP).

Surface runoff and seepage water from the slag dump will be monitored weekly to detect any changes in its potential to be leached that may potentially affect aquatic life if discharged into nearby water bodies.

Archaeology and Cultural Heritage

Potential Impacts

The key potential impacts on archaeological and cultural heritage sites that could potentially arise during the construction and operation phases of the project relate to accidental damage and / or loss of archaeological and cultural heritage sites. There are no known archaeological and cultural heritage sites at the project site.

Mitigation Measures

A “chance finds procedure” as required under IFC Performance Standard 8 (Cultural Heritage) will be implemented during construction works. The National Heritage Conservation Commission and other relevant authorities will be informed should any discovery of archaeological and cultural heritage sites be made during the construction and operation phase of the project.

Traffic Volume

Potential Impacts

Dump trucks hauling slag from smelter to the proposed new dump site will be cross the T3 and T5 roads. The key potential impacts associated with increase in traffic crossing the T3 and T5 and the interaction of dump trucks with pedestrians and cyclists are:

- Public safety risks and traffic-related accidents leading to injuries, loss of life and damage to property;
- Traffic congestion on T3 and T5 caused by dump trucks crossing the roads.

Mitigation Measures

The proposed measures to mitigate the identified impacts are:

- Installing traffic signs at T5 crossing. The signs should include “Trucks Crossing”, and “Slow Down” traffic signs.
- Lining the route with traffic-calming devices, especially near the crossing point of the dump trucks;
- Installing speed humps near the crossing point on T5 Chingola-Solwezi Road;
- Installing rumble strips on either side of T5 and T3 roads to slow down traffic toward the T3 and T5 crossing points;
- “Trucks Crossing” signs should be installed at T3.

- Improving safety communication.

Noise

Potential Impact

Noise disturbance to identified sensitive noise receptors (workers, residents of Mushishima Settlement and the Mushishima Primary School) caused by construction works and movement of dump trucks is the key potential impact associated with the project.

Mitigation Measures

Best practicable means of reducing noise levels within the recommended maximum allowable limits should be used by, among other measures:

- Ensuring that all construction vehicles are well maintained and operated within their efficient performance parameters;
- Providing construction workers and dump truck drivers with personal ear protectors to protect them from risks of hearing;
- Fitting site construction vehicles and dump trucks used for haulage of slag from smelter to dump with effective exhaust silencers and maintaining them in good efficient working order.

Radiological Survey

Potential Impacts

The slag that will be dumped at the proposed slag dump contains radioactive material. The key potential impacts associated with the hauling of slag from smelter and dumping it at the proposed slag dump are:

- Contamination of the area surrounding TD2 with radioactive material;
- Possible contamination (with radioactive material) of the route to be adopted as the slag is being moved from the smelter to TD2 Slag Dump;
- Possible pollution of the Chingola stream with radioactive material as the area around TD2 drains into the same stream.

Mitigation Measures

The following are the recommended measures that should be implemented to mitigate contamination of the environment:

- Slag will be transported while its moisture content is still high to avoid being blown off during transportation. In a case of accidental spillages, spilled slag should be removed and disposed at the slag dump;
- Planting of vegetation around the proposed slag dump site to trap any particles that may escape and contaminate the environment;
- Construct a perimeter drain leading to a point where solids could settle and be reclaimed and put back into the dump;
- Come up with a closure programme that will include covering the slag material with soil and establish vegetation on top.

It is further recommended that the following measures / recommendations should be implemented:

- Training workers that shall be working at he proposed slag dump in radiation safety;

- Developing and implementing a deliberate policy of radiation monitoring at the proposed dumping site, Chingola stream (at Chililabombwe road bridge and the confluence with Mushishima stream), along the access route at selected points, and at other appropriate points to be selected, at least once a month:
- Constructing wheel baths for the dump trucks, one at the Acid Plant Gate and the second at the exit of the proposed site at TD2.
- Posting signage around the slag dump perimeter to warn the public of radiation and unauthorised access;
- Creating public awareness on the dangers of being exposed to radioactive substances;
- Fencing off the dump site and providing 24 hours tight security to stop possible public accessibility;
- Covering the slag dump surface with 30cm of soil and establish vegetation cover at closure of the dump.

Socio-economics

Potential Impacts

The proposed project will not induce any loss of land, customary rights and settlements for the surrounding communities, as the project is located on mine land. In addition, the project will not induce any loss of amenity assets, loss of ethnicity, loss of access to common resources (water front, forest, etc.) and damage to agricultural or related assets.

The key potential negative impacts that the project can give rise to are the following:

- Noise disturbance on noise-sensitive receptors arising from the movement of dump trucks;
- Dust emissions caused by the movement of dump trucks along the access road;
- Traffic-related risks and accidents caused by the interaction of pedestrians, cyclists and dump trucks hauling slag from the smelter to the proposed dump site, increase in traffic crisscrossing the T3 and T5 roads;
- Surface water pollution in the Mushishima Stream;
- Security concerns arising from potential influx of illegal miners into Mushishima Community;
- Restriction of local communities to use the existing access road.

Mitigation Measures

The following are the proposed mitigation measures for identified significant impacts:

Noise disturbance

- Ensuring that all construction vehicles are well maintained and operated within their efficient performance parameters;
- Fitting site construction vehicles and dump trucks used for haulage of slag from smelter to dump with effective exhaust silencers and maintaining them in good efficient working order.

Dust emission

- Suppression of dust from haulage road will be done by using water bowsers and/or molasses.

- Applying speed controls to reduce dust releases associated with high speed movement of mobile equipment. A slow moving mobile equipment will result in significant reduction in dust releases from unpaved access roads;

Traffic related risks and accidents

Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of road users, including those who are most vulnerable to road traffic accidents such as cyclists and pedestrians.

The recommended measures include:

- Adopting limits for trip duration;
- Minimizing pedestrian interaction with operational vehicles by ensuring that traffic routes for dump truck and pedestrians are adequately segregated;
- Collaborating with local communities and responsible authorities to improve signage, visibility and overall safety of roads;
- Embarking on community awareness aimed at educating and sensitising the local communities and other road users on traffic and pedestrian safety and the need to adhere to traffic rules and regulations;
- Lining the route should with traffic-calming devices, especially near the crossing point of the dump trucks;
- Improving safety communication – the local community may be at risk from a potential traffic hazards arising at the dump trucks movements. The communication measures to alert the community should include:
    - Communicating details of the nature of the traffic hazard;
    - Communicating safety options;
    - Providing advice on selecting an appropriate route that minimises interaction with heavy equipment;
    - Collaborating with local communities on education about traffic and pedestrian safety;

Water Pollution in Mushishima Stream

- Routine sampling and testing of seepage and runoff from the slag dump to monitor and assess any potential contamination that may contribute surface water pollution.
- Provision of toe drains and under-drainage filters along the periphery of the dump to collect surface runoff and seepage as per design report;
- Constructing silt traps along the periphery of the dump as per design report;
- Constructing a drainage system at the slag dump that will channel any surface runoff and seepage from the slag dump to TLP.

Security

- Extending and tightening security patrols within the project area.

Positive Project Impacts

The positive impacts of implementing the project are securing of direct and indirect employment opportunities for KCM Smelter employees and contractors, safeguarding of livelihoods of employees and

other contractors at smelter dependent on income from smelter for their livelihood, continued promotion of local economy through supply of goods and services to smelter as it continues to be operational, and sustained revenue to government through taxes. The positive impacts will be enhanced by allocating adequate resources to the project.

Environmental and Social Management Plan

An environmental and social management plan (ESMP) for the construction and operation of the slag dump has been developed based on identified potential environmental and social impacts predicted to occur during project implementation and on proposed mitigation measures. The ESMP consolidates measures to mitigate significant environmental and social impacts, and provides a framework for implementing and monitoring the effectiveness of management actions that have been recommended to manage the construction and operations of the slag dump.

The proposed slag dump will also be constructed and operated in accordance with the applicable Zambian legislations and existing KCM Sustainability policies and procedures.

Environmental Monitoring and Auditing

Environmental monitoring of project activities will be undertaken by the environmental department. The existing surface and ground water monitoring protocols will be extended to the proposed project. This will include monitoring of seepage water and surface runoff from the dump. Dust fallout and radiation monitoring will also be monitored. The frequency monitoring and the indicative parameters to be monitored are presented in the environmental monitoring plan included in this document.

Environmental auditing and inspections of the operations of the proposed slag dump will be undertaken to assess compliance to commitments made in the Environmental and Social Management Plan for the project. In addition, environmental auditing will be conducted to ensure that environmental monitoring activities being undertaken at the site are accurate and relevant to meeting the environmental management objectives set in the plan and to meeting statutory obligations as required under the applicable Zambian legislations.

The proposed Slag Dump will be subjected to both internal and external audits.

Incidents and Accidents Action Plan

An incident and accident action plan has been formulated based on the identified hazards associated with the haulage of slag to the proposed dump site. The plan includes management actions to prevent incidents or accidents that could result in injuries, loss of life and damage to property. The plan will be reviewed to take into account changing circumstances. The periodic reviews of the plan will ensure that precautions put in place to control the risks are effective.

Decommissioning and Closure Plan

The decommissioning and closure phase of a project should be implemented to protect public health and safety, to reduce or prevent environmental degradation; and to allow a productive use of the project site, similar to its original use or an acceptable alternative. The decommissioning and closure activities of the proposed project will be implemented to achieve the same objectives.

The conceptual plan for the decommissioning and closure of the proposed slag dump is based on the assumption the dump will permanently remain at the site after decommissioning and closure. It has taken into account that the slag contains radioactive material which poses considerable risks to public health and safety. Therefore, in order to protect public health and safety, the conceptual plan includes undertaking the following activities at decommissioning and closure:

- Maintaining the fence off around the dump after decommission and closure and continuing with provision of security to stop possible public accessibility;

- Covering the slag dump surface with 30 cm of soil and establishing vegetation cover on top of the dump at closure of the dump;
- Progressively rehabilitation of the dump should be undertaken to minimise public health and safety risks associated with the dump.

KCM is committed to preparing a detailed Decommissioning and Closure Plan for the slag dump site to ensure that decommissioning, rehabilitation and final closure of the slag dump meets defined objectives targeted at protecting public health and safety and minimising long-term environmental impacts and costs. The plan should respond to the requirements of Zambian legislations and should to meet the requirements of the Equator Principles, the International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability and Vedanta Resources Plc Sustainability Governance System Technical Standard on site Closure.

Conclusion

This ESIS has been prepared in accordance with the requirements of applicable Zambian legislations and in conformance the requirements of the IFC Performance Standards on Social and Environmental Sustainability and Vedanta Resources Plc Sustainability Governance System. It has been prepared through a stakeholder consultation process.

Mitigation measures to enhance the beneficial impacts and to avoid, reduce or remediate negative environmental and social impacts have been included in this document. Implementation of the measures will be monitored to assess their effectiveness and to adjust them where appropriate.

With the effective implementation of the proposed mitigation measures presented in this document, the construction and operation of the proposed slag dump is not likely to result in negative environmental and social impacts and risks. The project will contribute to continued operations of the smelter with the subsequent securing of employment opportunities for both KCM employees and contractors.

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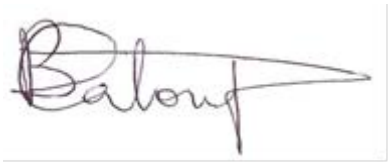
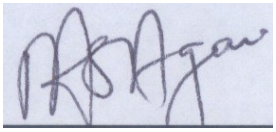
Chief Executive Officer

Konkola Copper Mines Plc

Names and signatures of the ESIA Project Team

Name	Signature	Expertise
Patrick Kampengele		Project Director
Boston Katongo		Lead EIS Author / Principal Environmental Scientist
Mitulo Silengo		Social Scientist / Economist
Chalwe Bulaya		Principal Civil / Environmental Engineer
Stephen Syampungani		Ecologist
Zebedia Phiri		Water Resources Expert
James Kalowa		Air Quality Specialist
Kenneth Kondowe		Soils Expert

1 INTRODUCTION

This Environmental and Social Impact Statement (ESIS) presents the findings of the Environmental and Social Impact Assessment (ESIA) study for the proposed New Slag Dump (the Project) at TD2 in Chingola. The Project is proposed by Konkola Copper Mines Plc (KCM) whose registered office is indicated in Table 1.1 below. The company is majority owned by Vedanta Resources Plc. The details of shareholding are presented in Table 1.1.

URS Scott Wilson was commissioned by KCM to prepare this ESIS for the Project. This ESIS is based on the Terms of Reference (ToR) for the Project (Appendix A), which were submitted to the Zambia Environmental Management Agency (ZEMA) and approved on 14th April 2014. The ToR set forth the scope of the ESIA study and the extent of the information collected and assessed in preparing this ESIS.

The ESIS has been prepared in accordance with the requirements of the Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No.28 of 1997), which stipulates issues to be covered in conducting an ESIA study and the stages that must be followed. It has also been prepared in line with the requirements of Vedanta Sustainability Framework. Site specific conditions have also been taken into account in determining the likely significance of the issues that have been covered in the study.

The document takes into account the public views and concerns gathered at the public consultation meeting (Scoping Meeting) held at Mushishima Primary School on 2 October 2013 as part of the ToR preparation process and during the consultations undertaken as part of the baseline surveys.

1.1 Overview on Konkola Copper Mines Plc

KCM is a subsidiary of Vedanta Resources Plc (Vedanta), a London-listed diversified FTSE 100 metals and resources group with operations in India, Australia, South Africa, Namibia, Zambia and Ireland. Vedanta Resources holds 79.4% of the issued and outstanding ordinary shares of KCM while the remaining 20.6% interest is held by ZCCM-IH, a Lusaka and Euronext listed company that is 87.6% owned by the Zambian Government and 12.4% owned by public shareholders. The Government of the Republic of Zambia has a golden share.

KCM will develop, manage and operate the proposed New Slag Dump once approval of the project is granted by ZEMA. KCM will hold all the operating approvals for the project. Table 1.1 presents KCM's registered office contact details, shareholding, the current company board of directors and other relevant details.

Table 1.1: Name and Details of the Project Developer	
Name of Project Developer	Konkola Copper Mines Plc
Address and contact details	**Address:** Stand M/1408, Fern Avenue, Chingola, Zambia. **Postal Address**: Private Bag KCM (C) 2000, Chingola, Zambia. Tel No.: +260 212 350604 E-mail: corporate.communications@kcm.co.zm
Ownership	79.4% Vedanta Resources Plc 20.6% ZCCM - Investment Holdings Golden share – Republic of Zambia
Mine Licence	LSM 34
Mine Chief Executive Officer	Mr. Steven Din
Company Board of Directors	Mr. Navin Agarwal Chairman Mr. Deb Bandyopadhyay Director Mr. Hastings Mtine Director Mr. Liver Tembo Director Mr William Kabwe Director Mr Manish Dawar Director Mr D D Jalan Director Mr Steve Din Director
Project Contact Person	Mr. Field Kondowe – General Manager Smelting and Refining

1.2 Project Background and Rationale

KCM owns and operates Nchanga, Konkola, Nkana and Nampundwe mine sites in Zambia. Nampundwe mine site is located in Lusaka Province while the other mines are located on the Copperbelt Province. At its Nchanga Mine Site in Chingola, KCM undertakes both underground and open cast mining operations.

In 2008, KCM commissioned the Nchanga Copper Smelter at Nchanga Mine to smelt copper concentrates from its own concentrators and other concentrates purchased from some other mines within and outside the country. The smelter is located within the main plant area at Nchanga mine site and it has a design capacity of 300,000 tonnes of finished copper per year. The main products produced from the smelter are copper anodes and the

waste product is granulated slag. An estimated 35,000 tonnes of granulated slag is generated per month, which is about 1,000 to 1,500 tonnes of slag per day.

The slag is currently disposed of at Slag Dump No.25, which is owned and operated by KCM. The dump is situated within the KCM Mine License area (LSM 34) and has been formed by end-tipping of granulated slag material from dump trucks and evenly spreading it outward using a loader or grader. This has resulted in the formation of dump slopes that are at the natural angle of repose of the slag material. Over 1.75 million tonnes has so far been dumped. With continued smelting operations, the dump is rapidly approaching its design capacity of 2.6 million tonnes. There is currently inadequate space to dispose of the slag. Therefore, there is need for an alternative dumping space within KCM Surface Rights in Chingola before the existing dump reaches its design capacity.

Expansion of the existing dump is constrained by the presence of Block "A" Open Pit on the north-western edge, the Chingola Stream which lies approximately 300 metres on the south-western edge, the Chingola - Chililabombwe public road at approximately 400 metres on the south-western edge, and the KCM Haulage Road and drain located on the eastern flank. There is also a power line on the southern periphery of the existing dump.

KCM has, therefore, proposed to undertake the project to construct and operate a new Slag Dump. The proposed and preferred site for the new Slag Dump is the already reclaimed TD2 tailings storage facility (TSF). According to the dump design, the proposed dumpsite has a 20 years lifespan.

1.3 Objectives of the Project

The objective of the project is to dispose of slag material in a safe and environmentally friendly manner by constructing and operating a new slag dump.

1.4 Proposed Project Location

The proposed preferred slag dump site is situated within KCM Mining License Area and is within the reclaimed TD2 tailings storage facility footprint. It is adjacent to the Western flank of TD7 tailings storage facility. TD7 is currently being used as an emergency tailings dam. The site had previously contained large volumes of tailings which have since been reclaimed by hydraulic monitoring means. It is a substantially reclaimed area with largely no vegetation cover; there is only very limited grass cover in a few and isolated places but a very large area is bare. The site is characterised by small bare anti-hills and heaps of the remaining tailings. Figure 1.2 shows the location of the proposed site.

1.5 Estimated Project Cost and Implementation Schedule

The estimated total project cost for the first phase is USD 950,000.00. However, the estimated cost for the entire 40 ha project life is approximately USD 10 Million as detailed in the dump site engineering design. The project implementation has been planned to commence once approval has been granted by Zambia Environmental Management Agency (ZEMA).

1.6 Previous Experience in similar Projects

KCM has demonstrable experience in constructing and operating slag dumps. The existing slag dump has been constructed and operated by KCM since 2010. The dump is inspected

routinely while statutory inspections are undertaken by independent competent persons every two years. The dump is operated as required under the Mines and Minerals (Environmental) Regulations, 1997 and is compliant with all ZEMA licence conditions.

2 LEGAL AND ADMINISTRATIVE FRAMEWORK

This section outlines the legal and administrative framework within which the project will be implemented. It outlines the relevant national legislations and international agreements. The section also includes KCM's sustainability policies.

2.1 Relevant Regulations

New Slag Dump Project will be implemented within the Zambian legal and administrative framework and KCM Policies and plans. It will also be implemented to conform to international conventions and international best practices outlined in the Equator Principles (EP), the 2012 version of the International Finance Corporation (IFC) Performance Standards and Environment Health and Safety (EHS) Guidelines.

2.2 National Legal and Administrative Framework

Environmental Management Act, 2011

The Zambian Environmental Management Act (EMA), 2011 is the superior Act on matters relating to environmental protection and management. Its superiority is outlined in Section 3 of the Act. The Act sets out a framework for Environmental Impact Assessments (EIA's). The Act mandates ZEMA to do all such things as are necessary to ensure the sustainable management of natural resources and the protection of the environment, and the prevention and control of pollution.

The Act outlines principles governing environmental management and provides for, among other things, Environmental Impact Assessment and regulations relating to environmental assessments. It has also spelt out offences relating to failure to prepare and submit an EIA report for projects that require such reports.

The projects that require preparation of EIA reports must be approved by ZEMA prior to implementation. Section 29 of the Act specifically states that "a person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, and except in accordance with any conditions imposed in that approval".

The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 (Statutory Instrument No. 28 of 1997) specifies the requirements for an EIA and it also sets out in its Second Schedule projects for which EIAs are applicable. It provides specific guidelines for conducting environmental impact assessments. The regulations require project developers undertaking projects that may have significant effect on the environment to conduct environmental impact assessment prior to obtaining written approval from ZEMA on implementation of the project. Regulation 3 of the Instrument specifically states that "A developer shall not implement a project for which a project brief or an environmental impact statement is required under these Regulations, unless the project brief or an environmental impact assessment has been concluded in accordance with these Regulations".

The Environmental Management (Licensing) Regulations, 2013, a subsidiary legislation of EMA, 2011, is applicable in the implementation of the proposed project. Regulation 12(1) states that "A person who intends to reclaim, re-use, recover, recycle, transport, dispose of,

transit, trade in, export waste or collect and dispose of waste from industrial, commercial, domestic or community activities or own, construct or operate a waste disposal site or facility shall apply to the Agency for waste management licence in Form III set out in the First Schedule".

KCM intends to transport and dispose of slag, a waste generated from smelting of copper concentrates, a disposal site planned to be constructed, owned and operated by the company (KCM). Therefore, KCM will comply with the regulations by applying to the ZEMA for a waste management licence and will operated the Slag Dump in accordance with the provision of the regulations and licence conditions.

KCM will also be required to keep a record of the operations of the Slag Dump in relation to waste management and will be required to submit the record to ZEMA twice a year from the commencement of transportation and dumping of slag at the proposed dump site. KCM will also be required to ensure that generated slag is disposed of in an environmentally sound manner and will take reasonable measures to prevent the slag from being used for unlawful purposes. This is will be carried out as required under Regulation 13 of the Environmental Management (Licensing) Regulations, 2013.

KCM will be the holder of the waste management licence and will therefore be required to provide appropriate personal protective equipment (PPE) to employees likely to be exposed to the slag during transportation and dumping of the waste. The provision of PPE is in accordance with Regulation 51 of the Environmental Management (Licensing) Regulations, 2013.

The obligations of holder of emission licence are outlined in Regulation 7(2). These obligations include complying with the effluent and waste water standards prescribed in the Third Schedule of the Environmental Management (Licensing) Regulations, 2013 and to carry out regular effluent or discharge quality monitoring and submitting the records of monitoring to ZEMA twice per year. The Regulations further obliges the holder of the licence to employ Best Management Practices (BMP) to control or abate the discharge of pollutants into the environment. KCM will comply with the regulations by monitoring any discharge from the dump and will use best management practices included in the design of the dump to control discharge of seepage and runoff from the dump into the environment.

Monitoring of groundwater will be undertaken as required under Regulation 15. The groundwater monitoring boreholes will be installed at proposed locations shown in Figure 6.3.

Therefore, the new Slag Dump Project will be implemented in accordance with the provisions of the EMA Act, 2011 and its applicable environmental regulations.

Mines and Mineral Development Act, 2008

The Mines and Minerals Development Act (MMDA), 2008 addresses issues of environmental, human health and safety in the mining sector in Zambia. The Mines and Minerals (Environmental) Regulations, 1997 (Statutory Instrument No. 29 of 1997), a subsidiary legislation of the MMDA, provides a framework for preparing and submitting environmental project briefs and environmental impact statements prior to undertaking any prospecting, exploration or mining operations (Regulations 3, 4 and 5). The regulations also

provide for, among other things, auditing of environmental and social management plans (Regulation 8), procedure to be followed before dumping (Regulation 11), mine site closure (Regulation 6) and associated decommissioning and closure costs (Regulations 5 and 66), storage areas and handling of hazardous materials (Part VI).

The Ionising Radiation Protection Act, 2005

The Ionising Radiation Protection Act, 2005 is the principal Act and is read together with the Ionising Radiation Protection (Amendment) Act, 2011. The principal Act provides for the establishment of the Radiation Protection Authority and defines its functions and powers. It provides for the protection of the public, workers and the environment from hazards arising from the use of devices or materials capable of producing ionising radiation. Section 7 of the Act outlines the functions of the Radiation Protection Authority which includes, among others, the following:

- Advising the Government on policies, measures and matters relating to ionising radiation;
- Implementing the policies of the Government related to the protection of the public, workers and the environment from harmful effects of ionising radiation;
- Liaising with the Zambia Environmental Management Agency or any other regional or international organisation and institution on matters relating to the promotion of the safe use of ionising radiation in Zambia;
- Ensure the protection and safety of the public in the event of an accidental release of harmful ionising radiation or other emergency;
- Responding to, and coordinating responses to radiological incidences and emergencies.

The Ionising Radiation Protection (General) Regulations, 2011 is a subsidiary legislation of The Ionising Radiation Protection Act 2005. The regulation states that the occupational exposure of any employee shall be so controlled such that an effective dose of 20 mSv per year averaged over five consecutive years, or 50 mSv in any single year shall not be exceeded. As for the public, the limit of 1 mSv per year has been adopted. All employees therefore dealing in radioactive materials should comply with this law.

Country and Town Planning Act, CAP 283

The Country and Town Planning Act provides for the appointment of planning authorities, for the establishment of a Town and Country Planning Tribunal, for the preparation, approval and revocation of development plans, and for the control of development and subdivision of land. It also provides for the assessment and payment of compensation in respect of planning decisions and for the preparation, approval and revocation or modification of regional plans, among other provisions. The Act does not however apply to Trust (State) Land and land in reserves or land in mining areas that fall under regional plans.

Employment Act CAP 268

The Employment Act provides legislation relating to the employment of persons and the engagement of persons on contracts of service. It also provides for the form of and enforcement of contracts of service, appointment of officers of the Labour Department and for the conferring of powers on such officers and upon medical officers. It further provides for the protection of wages of employees and the control of employment agencies; among other provisions.

Part V of the Act specifically outlines the requirements on written contracts of service for engagement of persons. Part VI of the Act outlines welfare issues pertaining to employees engaged under the Employment Act. KCM has human resources policy and procedures which are aligned with the requirements of the national and international labour laws. This policy and procedures are tools which KCM uses to ensure compliance. The proposed project will be operated within the confinements of the requirements.

Workers Compensation Act No. 10 of 1999

The Workers Compensation Act relate to the compensation of workers for disabilities suffered or diseases contracted during the course of employment and provides for the merger of the functions of the Workers' Compensation Fund Control Board and the Pneumoconiosis Compensation of fund for the compensation of workers disabled by accident occurring, or diseases contracted in the course of employment. It also provides for the payment of compensation to dependants of workers who die as a result of accidents or diseases. It further provides for the appointment and powers of a Workers' Compensation Commissioner, the establishment and functions of a workers' Compensation Fund Board and a workers' Compensation Tribunal; among other provisions.

The Act requires that employers, except the State, register with the Worker Compensation Fund Control Board (WCFB) within 14 days of commencement of business and to comply with the provisions of the Act. The Act also provides for payment of compensation to workers sustaining any injury while on duty. Section 51(1) outlines the worker's right to compensation. It states that "If an accident or disease occurs to a worker arising out of and in the course of employment and results in the worker's disablement or death, the worker, or if the worker dies, that worker's dependants shall be entitled to compensation in accordance with the provisions of this Act".

KCM will comply with the Act by ensuring that any contractor that will be engaged to work on the site is registered with the WCFB. In case of any accident or disease occurring and resulting in the disablement or death of a worker during implementation of the proposed project, compensation will be paid in accordance with the provisions of the Act.

Section 88 of the Act obliges employers to report to the Workers' Compensation Commissioner, within three days after having gained knowledge, any occurrence of an accident or incident of a disease in respect a worker. Should any occurrence as described in the Act happen during project implementation, KCM will report to the Commissioner in accordance with the provisions of the Act.

Table 2.1 presents a summary of some of the Zambian legislations that are relevant in the implementation of the proposed Project.

Table 2.1: Summary of some of the Zambian legislations relevant to the proposed Project			
Legislation	**Summary**	**Relevance to the Project**	**Implementing Authority**
Environmental Management (Licensing) Regulations, 2013 (SI No. 112 of 2013)	The regulations provide for licensing requirements for air emissions, discharge of effluents and wastewaters into the environment, hazardous waste management (storage, transportation, pre-treatment, disposal, labelling and packaging, importation, exportation, etc.), pesticides and toxic substances and ozone depleting substances. The regulations set out guidelines and limits where applicable and general provisions. The general provisions relate to personal protective equipment, validity of licence, amendment and surrender of licence, transfer and renewal of licence, site restoration order, prevention order, protection order, environmental restoration order, compliance order, among other provisions. The obligations of the licence holder are sent in the regulations.	KCM generates slag as waste from the smelting process at Nchanga Mine and the slag is currently dumped at the existing Slag Dump No.25. When the existing slag dump is filled to its design capacity, the slag will be transported and disposed of at the proposed New Slag Dump situated at TD2. The proposed New Slag Dump will be owned and operated by KCM. KCM shall therefore apply to ZEMA for a Waste Management Licence and other applicable licences in accordance with the requirements of the regulations. It shall also comply with the waste management requirements prescribed by the Chingola Municipal Council (CMC).	ZEMA / CMC
Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 (SI No. 28 of 1997)	Provides specific guidelines for conducting environmental impact assessments and for evaluation of environmental impact statements prior to undertaking any prospecting, exploration and mineral processing in the mining sector in Zambia.	For the project to be implemented an ESIS has to be prepared and submitted to ZEMA for approval. The proposed project requires an ESIA study, which should be approved by ZEMA, prior to project implementation	ZEMA
Mines and Minerals (Environmental) Regulations, 1997 (SI No. 29 of 1997)	Provides for preparation and submission of environmental assessment reports. It also provides requirements for the approval of mine residue deposits, air quality and emission standards, waste standards, storage handling and processing of hazardous material, and requirements for an environmental protection fund.	The proposed project involves dumping of slag material from copper concentrate smelting process at the proposed site. It is a mining operation that requires regulation to safeguard the environment and human health and safety. Dumping operations must conform to the stipulated guidelines in the regulations.	MSD
Mines and Minerals (Environmental Protection Fund) Regulations, 1998 (SI No. 102 of 1998)	Provides for mechanism of setting up and operating the Environmental Protection Fund (EPF).	The proposed project will be subject to independent annual environmental audits and evaluation with the view of ascertaining the company's environmental	Mines Safety Department (MSD)

Table 2.1: Summary of some of the Zambian legislations relevant to the proposed Project			
Legislation	**Summary**	**Relevance to the Project**	**Implementing Authority**
		performance and contribution towards the EPF.	
Pneumoconiosis Act, 1994	Provides for the medical examination and standards of physical fitness to be required of persons exposed or likely to be exposed to the risk of pneumoconiosis. All mine employees that work in scheduled mine and scheduled places will be required to undergo periodical examinations to ascertain their fitness to work in such areas where humans are likely to be exposed to free silica in reparable dust with particle sizes less than 5 microns, which becomes harmful when inhaled for over a long period.	The project work place (slag dump) will be in the scheduled mine and scheduled place. Employees will be exposed to dust and will therefore be subjected to periodic examinations to ensure that they are physically fit to work.	MSD
National Heritage Conservation Act, 1989	Provides for the establishment of the National Heritage Commission responsible for the conservation, restoration, rehabilitation, reconstruction, adaptive use and good management of ancient, cultural and natural heritage of aesthetic, historical and archaeological nature. The Act aims at preserving local culture and sites that have national significance, monuments and shrines.	Artefacts of cultural heritage value that will be discovered during the construction and operations of project will be handled in accordance with the provisions of the Act.	National Heritage and Conservation Commission
The Land Act, 1995	Provides for holding of land into the following categories that include state, local authority and traditional land.	KCM owns the surface rights to the Nchanga mine surface rights area within which the project falls.	Ministry of Lands, Natural Resources and Environmental Protection
The Local Government Act, 1995	Provides for the establishment of local councils and districts, and specifies the functions of local government some of which relates to environmental protection and natural resources management functions. These include preventing pollution of water supplies.	KCM will be required to liaise with the local authorities at Chingola and will also be required to comply with the relevant by-laws enacted by the Council to ensure that project execution runs smoothly without any hindrances and does not pollute water supplies sources.	Ministry of Local government and Housing

Table 2.1: Summary of some of the Zambian legislations relevant to the proposed Project			
Legislation	**Summary**	**Relevance to the Project**	**Implementing Authority**
Forest Act, 1973	The Act provides for the establishment and management of National Forests and Local Forests and makes provision for the conservation and protection of forests and trees; and provide for the licensing and sale of forest produce.	Indiscriminate cutting of trees within the project site will be discouraged. Where trees are cut, vegetation programme will be implemented to offset the losses.	Ministry of Lands, Natural Resources and Environmental Protection
Public Health Act, 1995	The Act relates mainly to the control and notification of infectious diseases. Parts of the Act (Part IX) relate to sanitation and housing. It places an obligation on all individuals and on property owners not to allow nuisance situations which could lead to the spread of infectious diseases.	The project staff will be working at the site during construction and operation phases and there activities should not allow nuisance situations that could lead to spread of infectious diseases within and around the project area. Project implementation should include putting in place measures to prevent the spread of diseases in accordance with the Act and Waste Management Regulations.	Ministry of Local Government and Housing
Water Resources Management Act, 2011	The Act provides for the establishment of the Water Resources Management Authority and defines its functions and powers. It provides for the management, development, conservation, protection and preservation of the water resources and its ecosystems. It also provides for equitable, reasonable and sustainable utilization of water resources, among other provisions. The Act specifies activities where permits are required.	Surface run-off and seepage from the proposed Slag Dump should not contribute to pollution of water resources that may render its use by other stakeholders unsustainable.	Ministry of Mines, Energy and Water Development
Public Roads Act, 2002 (amended in 2006)	The Act establishes the Roads Development Agency, which is responsible for the care, maintenance and construction of public roads in Zambia.	The dump trucks will be transporting slag from the Nchanga Smelter to the proposed site across the T3 (Chingola – Chililabombwe road) and T5 (Chingola – Solwezi Road). KCM will therefore liaise with Roads Development Agency (RDA) regarding the additional traffic that will be hauling slag across the public roads and will put in additional traffic signage, where required in particular where the haul road	RDA

Table 2.1: Summary of some of the Zambian legislations relevant to the proposed Project			
Legislation	**Summary**	**Relevance to the Project**	**Implementing Authority**
		will cross the Chingola – Solwezi Road.	
Road Traffic Act, 2002	The Act establishes the Road Transport and Safety Agency and defines its functions; it provides for a system of road safety and traffic management; licensing of drivers and motor vehicles; registration of motor vehicles and trailers; compulsory third party insurance of motor vehicles; licensing and control of public service vehicles; promotion of road safety; regulation of road transport between Zambia and other countries with which Zambia has concluded cross-border road transport agreements. It also provides for implementation of the SADC Protocol on Transport, Communications and Meteorology among other provisions.	KCM will be transporting slag across two public roads. Therefore, KCM will be required to comply with the provisions of the Act and its subsidiary legislations to ensure road safety during transportation of slag.	Road Transport and Safety Agency.
Occupational Health and Safety Act, 2010	This Act provides for the establishment of the Occupational Health and Safety Institute and for its functions. It provides for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work. It further provides for, among other provisions, the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.	KCM shall comply with the Act by ensuring, so far as is reasonably practicable, the health, safety and welfare of all the employees. It shall place and maintain employees in an occupational environment adapted to meet the employees' welfare as required under the Act. KCM shall further provide, among other provisions, systems of work that are safe and without any risks to human health as required under the Act.	Occupational Health and Safety Institute
Ionising Radiation Protection Act, 2005 / Ionising Radiation Protection (Amendment) Act, 2011.	The principal Act provides for the establishment of the Radiation Protection Authority and defines its functions and powers. It provides for the protection of the public, workers and the environment from hazards arising from the use of devices or materials capable of producing ionising radiation.	KCM will comply with the provisions of the Act to ensure that the public, workers and the environment are protected against any potential sources of ionising radiation.	Radiation Protection Authority

2.3 International Conventions and Agreements

Table 2.2 summarises international conventions and agreements to which the Zambian Government is a party and which are applicable to the project. The agreements and protocols impose obligations on Zambia to address issues or topics included in these documents.

Zambia has also been a member of the International Atomic Energy Agency (IAEA) since 1969. The IAEA is the world's centre of cooperation in the nuclear field and works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. Reference was made to the IAEA in undertaking the radiological assessment for the proposed project.

Recommendations and guidance on radiation protection from the International Commission on Radiological Protection (ICRP) have been referred to as well in undertaking the radiological assessment. Established in 1928, ICRP is an independent, international non-governmental organisation providing recommendations and guidance on radiation protection. It has therefore vast experience in radiological issues.

Table 2.2: International Conventions relevant to the Project

Convention	Relevance
Convention on Biological Diversity (ratified in 1993)	The objectives of the Zambia's National Biodiversity Action Plans include, ensuring the conservation of a full range of Zambia's natural ecosystems through a network of protected areas, development and implementation of strategies for conservation of biodiversity, sustainable use and management of biological resources. Biological resources of significant conservation value that will be identified during Project implementation will be conserved and protected.
Convention on Wetlands of International Importance (1975)	The Convention aims at promoting conservation and sustainable use of wetlands and their resources for the benefit of the present and future generations. The Project development and implementation would need to be undertaken in a way that should not comprise the ecological character of the nearby water bodies.
Convention Concerning the Protection of World Heritage (1972)	The Convention aims at ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage. Cultural and natural heritage sites that may be identified during implementation of the proposed Project will be protected and conserved in accordance with the provisions of the Convention to which Zambia is party to.

2.4 International Standards

This ESIS makes due reference to internationally recognised standards in order to establish a transparent regulatory framework for the Project which is in line with both national requirements and the expectations of international stakeholders.

The Equator Principles (EP) are a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. They are adopted voluntarily by international financial institutions to ensure that projects financed by these institutions are developed in a manner that is socially responsible and reflect sound environmental management practices. They are based on and implemented in accordance with World Bank Group's International Finance Corporation (IFC) Performance Standards on social and environmental sustainability and the IFC Environmental Health and Safety (EHS) Guidelines. The IFC is part of the World Bank Group and its standards and guidelines define both a robust approach to managing risks and impacts, and determine good international industry practice for significant project components.

KCM subscribes to the tenets of the Equator Principles and the IFC Performance Standards on social and environmental sustainability. Therefore, in the implementation of the Project, KCM will apply the EPs, 2012 version of IFC Performance Standards and EHS Guidelines upon which the Vedanta Sustainability Framework is anchored. The social and environmental impact assessments that have been undertaken for the Project also involved public consultation with all interested and affected parties and formulation of environmental and social management plans.

In order to ensure compliance with current international best practices, the environmental and social impact assessment study for the project was carried out in accordance with the policies, safeguard procedures, and guidance of the World Bank Group and Vedanta Sustainability Framework. It was also carried out to meet Zambian legislative requirements.

The IFC Performance Standards and EHS Guidelines relevant to the Project are briefly outlined below.

2.4.1 International Finance Corporation Performance Standards

The IFC Performance Standards set out the underlying principles for sustainable project management, including impact/risk assessment, mitigation strategies, public consultation and performance monitoring.

Their relevance to the Project is briefly summarised below:

- **IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts:** Establishes requirements for social and environmental performance management throughout the life of a project through initial baseline studies and identification of risks and impacts, establishment of management programmes that describe mitigation and performance improvement measures and actions to address identified risks and impacts, stakeholder engagement and application of management system to monitor and improve performance.

  KCM has compiled with the standard by undertaking baseline studies and identifying risks and impacts, and preparing an environmental and social impact management plan included in this report. Public consultation was also part of the ESIA process for the proposed project.

- **IFC Performance Standard 2: Labour and Working Conditions**: Highlights the need for workers' rights regarding income generation, employment creation, relationship management, commitment to staff, retention and staff benefits. It identifies and outlines

the need to provide workers with a safe and healthy working environment. This Performance Standard is guided by international conventions.

KCM manages its workers in accordance with the requirements of the International Labour Organisations, which are in line with IFC PS2.

- **IFC Performance Standard 3: Resource Efficiency and Pollution Prevention**: Defines an approach to pollution prevention and abatement in line with current internationally disseminated technologies and good practice. It deals with ambient and cumulative considerations, resource conservation and energy efficiency, hazardous materials and waste management, pesticide use and management, and emergency preparedness and response provisions.

  This standard is applicable to the project. An approach for pollution prevention has been proposed to be developed and implemented at the proposed slag dump in line with the requirements of IFC PS3.

- **IFC Performance Standard 4: Community Health, Safety and Security**: Specifies requirements for mitigating any potential for community exposure to risks and impacts arising from equipment accidents, structural failures and releases of hazardous materials. In addition, communities may be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel.

  Community exposures to dust emissions, radiation, traffic-related accidents and incidents have been assessed as part of the environmental and social impact assessment study for the proposed project. Mitigation measures that KCM has to implement to avoid and minimise impacts on the community have been recommended in line with the requirements of IFC PS4.

- **IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement:** Outlines a policy to avoid or minimise involuntary physical resettlement as a consequence of the project. Where it is unavoidable, it requires suitable measures to mitigate adverse impacts on affected stakeholders, including appropriate compensation for any economic displacement such as loss of subsistence or commercial livelihood.

  The assessment undertaken indicates that no land acquisition and involuntary resettlement will be carried out at the proposed site. The land is owned by KCM and there are no settlements. Should involuntary resettlement issues arise, KCM will comply with IFC P5 requirements.

- **IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**: Sets out an approach to protect and conserve biodiversity, including habitats, species and communities, ecosystem diversity, and genes and genomes, all of which have potential social, economic, cultural and scientific importance.

  KCM has undertaken an ecological assessment study for the proposed project in line with the requirements of IFC PS6. The assessment includes mitigation measures to minimise loss of vegetation on the periphery of the site.

- **IFC Performance Standard 7: Indigenous Peoples**: Recognises that Indigenous Peoples can be marginalized and vulnerable (such as, if their lands and resources are encroached upon by or significantly degraded by a Project). Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat.

  This standard is not applicable in the current setting as there are peoples classified as indigenous peoples in Zambia.

- **IFC Performance Standard 8: Cultural Heritage**: Aims to protect irreplaceable cultural heritage and to provide guidance for protecting cultural heritage throughout a Project's life cycle.

  KCM will comply with the requirements of IFC PS8 by ensuring that a chance find procedure is adopted and that any irreplaceable cultural heritage discovered during implementation of the project is protected in accordance with the provisions of the standard.

Evolving sustainability issues associated with climate change, biodiversity and 'eco-system services', human rights and gender, labour and supply chains, and stakeholder engagement with affected communities are included in the Performance Standards and in certain cases have been enhanced following review of Performance Standards.

2.4.2 Environmental, Health and Safety Guidelines

The IFC EHS Guidelines were designed to broadly define 'good international industry practice' and set specific minimum design and operating standards (such as for emissions, discharge or exposure limits) in regard to the environment, occupational health and safety, community health and safety, and life cycle impacts including during construction, operation and decommissioning.

The detail in these standards is generally derived from globally recognised sources (such as the World Health Organisation) and are basically intended for application where host government's legislation is either not available or is potentially deficient in regards to good international practice. Stipulated performance levels and measures are "generally considered to be achievable in new facilities by existing technology at reasonable costs".

However, there is also some flexibility in regard to both their application to existing facilities and the fact that less stringent measures can be adopted, provided that there is a detailed justification for any proposed alternatives as part of the site-specific ESIA. In the event of any unavoidable deviation from a performance measure stipulated in an EHS Guideline, the justification should be clearly explained.

The General EHS Guidelines are designed to apply to all projects and all sectors, but the detailed requirements can be superseded by sector guidelines, where factors such as facility size, technology and associated impacts merit specific attention. The specific industry sector EHS Guidelines that are applicable to the proposed project include the guidelines on Waste Management Facilities, Mining and Water and Sanitation, Base Metal Smelting and Refining.

2.5 KCM Sustainability Policies

KCM has nine sustainability policies adopted from the Vedanta Sustainability Framework. These policies are in line with the requirements of the IFC and the Equator Principles. They guide the way KCM manages sustainability issues as captioned in the policy names below:

- Safety Health and Environment;
- Security;
- Social;
- Biodiversity;
- Human Rights;
- HIV/AIDS;
- Water Management;
- Energy and Carbon;
- Supplier and Contractor Management.

3 THE PROJECT

3.1 Project Proponent

The project proponent is Konkola Copper Mines Plc (KCM) and will hold all project operating approvals and authorisations.

3.2 Project Overview

Slag dumpsite No. 25 was commissioned in 2010. During its operation some slag was dumped at an unauthorised site adjacent to the commissioned dump. The slag was later on shifted to the authorised dumpsite. This resulted in a drastic reduction of the dump's design capacity. Following the reduction in the storage capacity of the existing slag dump, KCM has proposed to construct and operate a new slag dump. The proposed site for the new slag dump is a brownfield site located at the reclaimed TD2 facility.

The proposed Slag Dump will have an operational life of approximately 20 years, storing an estimated 10.95 million tonnes of slag material. The proposed site covers 100 ha of the area while the proposed slag dump will cover a maximum footprint area of 40.5 ha, with about 59.5 ha remaining for future expansion of the dump.

A detailed design report is included in Appendix M. The design criteria as well as the principal deign parameters are discussed below.

The philosophy that forms the basis of the design of the granulated slag dump is to provide a cost effective storage of the slag material in a facility that is stable, safe and that mitigate adverse environmental and social impacts. The basic design criteria that have been adopted are outlined below:

- Effective stabilisation and compaction of the underlying foundation and access road to ensure overall dump stability;
- Stable configuration of the dump to ensure low aesthetic change to the surrounding environment and its surroundings;
- Management of seepage to mitigate against adverse environmental impacts;
- Storm-water management to avoid undue contamination of clean water; and
- Modular development of the dump in stages, to reduce the overall initial capital cost investment.

The design report also includes a Bill of Quantities for the preparatory works that will be required before dumping can commence. The following components form the design of the slag dump:

- Configuration and footprint analysis of the dump. This is based on a design dump height of 15 m;
- Selection of an under-drainage system for the dump including rainfall runoff management; and
- Slope stability analysis for the dump configurations.

Reference has been made to previous investigations on the site that were undertaken for the proposed TD7 Expansion (URS Scott Wilson, June 2011). Table 3.1 below gives the principle

parameters that have been used for the design:

Table 3.1 Design Parameters

Parameter	Design Factor
Daily Slag Production Rate	1500 tonnes per day
Design Life	20 Years
Final Design Storage Capacity	10,950,000 tonnes
In-situ slag density	1900 Kg/m^3
Foundation Soil Classification	SAND (tailings) and Silty Sand (Gravel)
Seismic Risk Classification	Low
Confining walls classification	Granulated Slag
Repose Angle of Slag	53^0
Seismic Loading gravitational acceleration factor	0.067g

The following material strength properties were used for the slope stability analysis. The parameters used are based on literature review, previous geotechnical tests that were undertaken during the TD7 expansion design process as well as additional data obtained from KCM.

Table.3.2: Material Strength Parameters.

Material Type	Saturated Density (KN/m3)	Effective Friction Angle ø' (degrees)	Effective Cohesion c' (kPa)
Tailings	17.7	24	14
Granulated Slag	19.0	53	0
Foundation	18.4	23	0

3.3 Project Location

The proposed slag dump site is located on the Copperbelt Province in Chingola District. It is within the footprint of the reclaimed TD2 Tailings Storage Facility (TSF), which is located within KCM Mine License Area at Nchanga Mine. The site has previously contained large volumes of tailing, most of which has since been reclaimed for mineral reprocessing. The remaining surface of the area is largely bare with isolated patches of grass vegetation in certain places. The surface is uneven with old anthills exposed in places where the

reclamation process has been completed. There are several old drainage paths that were used for directing tailings slurry into collection sumps during the active reclamation activities.

TD2, where the project site will be located, lies about 3 km North-West of the Smelter Plant Complex and approximately 5 km from Chingola Central Business District. It covers an area of about 100 ha. At its widest point, TD2 is approximately 1.5 km wide in a North-South direction. There is an open grassy area to the northern end of TD2 with a fall towards the Mushishima Stream, which is approximately 1 km further north. An access gravel road forms the boundary between the TD2 and the open northern area. Some sections of the northern area are covered with tailings eroded from TD2.

The TD2 pumping station is located immediately to the East of TD2. An access road running in a North-South direction forms the boundary between the pumping station and TD2. TD7 Tailings Storage Facility, which is also largely reclaimed, is located to the South of the proposed new slag dump site. There is an earth fill embankment between TD7 and TD2. The embankment forms the boundary between the two facilities.

The Mulenda Dairy Farm is located to the West and South-West of TD2. An access road, open drain and a partially wooded area forms a buffer boundary between the edge of TD2 and Mulenda Dairy Farm.

Figure 1.2 shows the location of the proposed project site for the new Slag Dump at TD2. The geographical coordinates that indicates the location of the proposed slag dump site are presented in Table 3.3.

Table 3.3: Geographical Coordinates of the proposed Slag Dump Site

Point	m E	m S
1	588403.20	865066.94
2	589232.64	8614691.35
3	589931.36	8615382.60
4	589990.78	8615455.41
5	589839.06	8615769.16
6	589108.79	8616258.73

3.4 Project Description

The various development phases of the proposed Project, which include the construction, operations and decommissioning stages, will be described in this section. The following describes the different project elements in more detail.

The principle raw material inputs into the project include construction aggregates, and filter drain material. The following material will be used in the project;

- Fine aggregate material for the filter drains;
- Coarse aggregate material for the filter drains;

Construction aggregates for the concrete works for the seepage collection sump.

As described in section 3.4.1 below, the remaining scope of site preparation will also include levelling of the site and preparation of the access road.

3.4.1 Site Preparation

The surface elevations at the proposed site range between 1292 metres above sea level (masl) and 1297 masl over the entire surface, with the high sections being around the central part of the dump. The proposed slag dump will is expected to cover approximately 100 ha. Uneven surface with anthills characterize the site. Therefore, site preparatory works will include leveling of the surface and infilling of some much lower section to provide an even surface over which dump trucks and other access vehicle will be able to pass safely during dumping. The detailed design report of the facility is included as Appendix D of the Approved Terms of Reference for the project.

The existing access road from the Smelter Plant to the Project Site via the adjacent TD2 reclamation pump station will be improved. The area of improvement will include grading and widening of the road. In addition, road safety will need to be improved particularly at the road crossing where the road intersects with the Chingola-Solwezi (T5) main trunk road. Figure 1.3 shows the preferred route to the proposed Slag Dump Site.

The access roads to the project site are currently used as access to other dumps that are further North of TD2 such as TD3 and TD4. Once the proposed slag dump is operational, dump trucks from the smelter to the proposed slag dump site will be using the same access roads to haul slag to the site.

Drainage along the access roads and around the site is another area that will need to be improved. Adequate buffer zones will be created between the edge of the dump and any existing external drainage systems.

3.4.2 Construction Phase

Construction phase will involve the construction of the drainage network around the Project Site. This will be done in the early stages of the project and also as and when the need arises during the operational phase. The drainage system around the proposed site will include capturing and treatment of surface run-off prior to discharge into the receiving natural watercourses. The Project site is drained by the Mushishima and Chingola Streams. Where ground profile allows, the drainage will be profiled so that it discharges into the Pollution Control Dam (PCD).

The key activities for the construction phase include the following:

The following main key activities will be undertaken as part of site preparation before dumping commences.

a. Prepare access road from the plant to the dump;

    i. Grade existing access road including widening;

    ii. Construct over the tailings an access road to the dumping locations.

b. Construct longitudinal and transverse filter drains;

c. Construct lined toe drain; and

d. Construct seepage collection sump.

Waste that will be generated at the construction site will be disposed of at designated disposal site. Domestic waste such as food packaging material will be collected by a licensed third party (Copperbelt Solid Waste Company) and disposed of at Helen Dump Site.

3.4.3 Operation Phase

The operation phase will involve hauling of slag material from the Smelter plant and dumping it at the proposed dump site. The material will be hauled in 30 – 40 tonnes dump trucks. Approximately 1500 tonnes of slag material will be dumped at the site per day and at least two dump trucks will be involved in the dumping operations.

The dumping operations will basically involve end tipping of the granulated slag from the dump trucks and the subsequent spreading and leveling of the material. The material will be spread and leveled using either a Grader or Dozer. Selection of the appropriate equipment to use will be determined by the amount of spreading required and the stage of the development of the dump. At elevated heights use of the more versatile Dozer will be appropriate. Material will be dozed outwardly towards the edges to ensure the dump slope profile is formed and at the same time ensure all material is within the designed footprint of the dump.

The design of the dump has taken into account the maximum height of the dump in relation to the surrounding environment. The proposed design will be to develop the dump site in modular cells with each cell storing up to one years' production of granulated slag.

The anticipated waste from the construction works is mainly construction rubble and un-reclaimed tailings, which will be disposed of at a designated dump site.

The physical and chemical properties of the slag that will be dumped at the proposed site will be similar in nature to the slag currently being dumped at the existing Slag Dump No. 25. It will be granulated and dull black in appearance. It is classified as abrasive. Its typical chemical composition includes Cu (0.49%), Fe (25.02%), SiO_2 (38.80%), CaO (7.12%), MgO (3.94%), Co (0.30%), S (0.27%), Al_2O_3 (8.68%) and Fe_3O_4 (0.9%). With regard to stability and reactivity, the material is stable. The slag leachability tests conducted by Alfred H. Knight show that the slag does not show any potential to be leached with tap water. However, it is leachable with a weak acid (AHK, 2014). The other physical and chemical properties are presented Table 3.4. The detailed Material Safety Data Sheet (MSDS) is presented in Appendix B.

Table 3.4: Physical and Chemical Properties of Granulated Copper Slag

Specific Gravity • True • Apparent	 3.5 – 3.7 1.0 – 2.1
Nature	Inert
pH	N/A
Solubility	Insoluble in water
Boiling Point ^{o}C	N/A
Melting point ^{o}C	Around 1200 ^{o}C
Vapour Pressure	N/A
Flammability	N/A
Flash Point	N/A

The following dumping procedures and guideline will guide the actual dumping operations. These procedures will be in addition to any specific conditions that may be outlined by the Mines Safety Department (MSD);

The basic dumping process is outlined below:

- The material will be hauled to the dump site by road using dump trucks;
- The material will be end-tipped from tipper trucks;
- During end-tipping tipper trucks will be operated in reverse direction;
- The material shall be heaped at a safe distance from the edge of the dump surface with a minimum approach distance of not less than 10m from the edge;
- The tipper trucks will be guided by the dump attendant to ensure the minimum set distances are not exceeded;
- The heaps of granulated slag are to be levelled using a Grader or Dozer;
- Levelling the surface to be an intermediate operation after sufficient quantities of slag have been heaped;

The following general guidelines will be applicable during all dumping operations:

- Ensure that all equipment being used is in good operational condition;
- The trucks should not be overloaded to avoid any spillages;
- Access roads to be maintained in a good condition at all times;
- Dumping of the material should commence from the outer boundaries of the dump;
- Trucks should dump the slag material while moving in a reverse direction up to the minimum set approach distance;
- An attendant should be present at all times to guide the trucks when dumping;
- Dump surface to be levelled and have no depressions;
- Design wall profiles and extent to be adhered to at all times;
- Regular cleaning of the toe drain, filter drain outlets and seepage sump to be undertaken.

3.4.4 Decommissioning and Closure Phase

The decommissioning and closure phase of the proposed project is presented in Section 9 of this document. The basis of the decommissioning and closure activities are to:

- To protect public health and safety;
- To reduce or prevent environmental degradation; and
- To allow a productive use of the project site, similar to its original use or an acceptable alternative.

4 Project Alternatives

The possible project alternatives that have been considered relate to the location of the slag dump and the dump site access routes. Site selection criteria involved taking into account three pillars of sustainable development, namely environmental, social and economic factors.

As a minimum, the preferred route should meet sustainability requirements in the disciplines that include safety, health, environment, economics, social and security.

Five sites have been identified within the KCM Mine License Area. The sites have been assessed based on the site selection criteria that take into account environmental, social and economic factors.

The subsections below give brief characteristics of the identified sites.

4.1 Site Location Alternatives

4.1.1 Site 1: North of OB1 (Overburden Dump No. 1)

This site is located to the North of OB1 and it is over 10 km to the Nchanga Smelter. It is a Greenfield with a modified habitat. There is no direct route to access the site.

The site was rejected because of long distance and non-existent of a direct route to access it. These factors can potentially increase the project costs and make the whole project economically unviable. In addition, the site is in a Greenfield, which could be destroyed should the slag dump be located at this site. This could negatively result in further loss of vegetation and fauna habitats, which can be preserved by utilising existing brownfields within KCM Mining License Area.

4.1.2 Site 2: South of TD3 and TD4

Site 2 is located to the South of TD3/TD4 over 11 km to the west of the Nchanga Smelter. It is a Greenfield site with a modified habitat. The site is very close to the Chingola – Solwezi road. Some local communities have settled in this area such that siting the slag dump in this area would require resettlement and/or compensation for some local communities.

Therefore, Site 2 was rejected principally because it could result in physical and economical displacement of the local communities. In addition, situating the Slag Dump at Site 2 could increase the project costs because of the long distance from the Smelter to site. This could be uneconomical considering the long haulage cycles the dump trucks could be making.

4.1.3 Site 3: Mimbula Area

Mimbula Area is located approximately 16 km to the South of the Nchanga Smelter. The site is a Greenfield site with a modified habitat. It has been so highly encroached by the local communities that locating the Slag Dump in area will require resettlement and/or compensation of people.

Therefore, Site 3 was rejected based on the fact that it could result in physical and economical displacement of the local communities, further loss of vegetation and fauna habitats, long distance from Nchanga Smelter compounded by non-existent of a direct route.

4.1.4 Site 4: Open Pit (main in pit)

Site 4 is located in the Nchanga Open Pit (main in pit). The site is near to the Smelter (about 7 km) but has safety risks on underground operations. It is a brownfield site with no significant

impacts on biodiversity. The site is not visible to the general public and no resettlement and/or compensation of people will be required.

Site 4 has, however, been rejected because of the significant safety risks it poses on underground operations that could lead to personal injuries, fatalities, damage to property and disruption of operations.

4.1.5 Site 5: TD 2 (Preferred Site)

Site 5 is located at the reclaimed TD2 tailings storage facility and is about 6 km west of the Nchanga Smelter. It is a brownfield site with no significant impacts on biodiversity. It is highly visible to the general public and there will be no resettlement and/or compensation issues associated with it should the Slag Dump be located at this site. The site has already an existing access road, which will need to be graded and widened.

Site 5, which is at the reclaimed TD2 tailings storage facility (Site 5), has been selected because it is a brownfield site and is near to the Nchanga Smelter. The site has adequate area (100 ha) that gives the proposed Slag Dump an expected lifespan of 20 years. Access road to the proposed dump is readily available. There are no resettlement or compensation issues associated with the preferred site.

Table 4.1 shows a list of chosen alternatives in the order of preference.

Table 4.1: List of Alternative Locations in the Order of Preference

Order of Preference	Site No.	Location
First	Site 5	Reclaimed TD2 Tailings Storage Facility
Second	Site 2	South of TD3 and TD4
Third	Site 3	Mimbula Area
Fourth	Site 1	North of Overburden Dump No. 1 (OB1)
Fifth	Site 4	Nchanga Open Pit (main Inpit)

4.2 Routing Alternatives

The first alternative dumping route considered partly follows the existing copper ore haulage to COP F. The alternative route branches to right off the existing ore haulage road immediately after crossing the T3 road (Chingola – Chililabombwe Road). It then follows an existing access road that runs on the margins of OB27 and OB19 before crossing the T5 road (Chingola – Solwezi Road). The existing access road continues after the T5 crossing and runs alongside the margins of TD7 and TD2, where the proposed project site is located. There are no settlements situated close to the first alternative dumping route considered. The approximate distance of the first alternative dumping route from the Smelter to the proposed project site is 6 km. Figure 1.3 shows the alternative dumping routes (Option 1 and Option 2).

The second alternative dumping route to the project site considered also partly follows the existing copper ore haulage road to COP F Open Pit. The second alternative road branches to the right off the ore haulage road after a stretch of 450 m from where it crosses T3 road (Chingola – Chililabombwe Road). It passes in between OB4 and OB27 very close to the COP A Open Pit and thereafter crosses the T5 road (Chingola – Solwezi Road) near Mushishima Settlement. It joins a narrow access road that runs on the southern edge of the TD7 and TD2 leading to the proposed project site. There is no existing access road from where the alternative road branches off the existing ore haulage to the narrow access road at

TD7. The approximate distance of the second alternative route from the smelter to the southern end of the project site is 7 km.

The first alternative dumping route has been selected because of the following reasons:

- There is already an existing route that will be used as the dumping route to the proposed site. The existing access route will just require widening and grading;
- There will be no opening up of new areas through extensive vegetation clearing to pave way for construction of a dumping route since the existing access route will be used.
- Dumping route considered does not pass or run close to settlements that may inevitably be disturbed by the movement of dump trucks to and from the project site.

The second alternative dumping route has been rejected because it will pass close the Mushishima Settlement and will require opening up of new areas that will result in vegetation clearing.

Table 4.2: List of Alternative Dumping Routes

Order of Preference	Option
First	Option 1 (Preferred) as shown in Figure 1.3
Second	Option 2 as shown in Figure 1.3

4.3 Alternative Designs

For a granulated slag dump, the design alternatives are principally based on the method of dumping. In this case two dumping method have been considered;

- Dumping by end-tipping from dump trucks; and
- Dumping using a conveyor belt system.

Each of the above two alternatives are discussed in more detail below.

Dumping Method

Alternative 1: Dumping by end-tipping from dump trucks.

For this alternative, the granulated slag material is transported to site using dump trucks and the material dumped in place through end-tipping. When a sufficient quantity of the slag material has been dumped, the material is spread using a dozer or grader to form a uniform top surface.

As one section of the dump reaches its storage capacity, dumping is then shifted to the adjacent planned dumping section. The development of the slag dump is in stages and this allows for the progressive rehabilitation of filled up sections of the dump site.

In terms of access to the dump site, there is already an existing access road which requires some widening in certain road sections, and therefore the cost of implementing this method of transporting and dumping the slag material is not only dependant mainly on preparing the dump site. There is not much additional infrastructure installation that will be required.

Alternative 2: Dumping using a conveyor belt system

In this type of dumping, the slag material is collected from the granulation tank through a chute and onto a conveyor belt which is then used to transport the material to a dump site and the material is dumped from a height on the proposed site. The dump forms into a cone

shaped dump. As the design dump height is attained, the conveyor belt is shifted to commence dumping at the next available dump space.

This option of dumping was not considered because of the following limiting factors;

The distance to the proposed site is over 6 Km long and this would have entailed a long conveyance system with multiple transfer chutes to take account of the infrastructure along the proposed route. The Smelter plant is surrounded by other plant infrastructure and office buildings which would require the conveyance system is constructed either below ground or at an extremely elevated height. The technical design details for such a method coupled with high construction costs would make the whole project economically unviable.

Common to both dumping methods is the provision of an under-drainage system. Under-drainage for slag dumps is a relatively new concept for preventing seepage to the underlying strata. Previous designs have normally not considered this aspect of slag dump design, given the relatively low moisture content in the slag material. However, best international practice and the need to ensure minimal seepage from any waste dumps, under-drainage systems are now considered for all types of waste dumps.

The under-drainage system that has been selected in the design is the installation of filter drainage system. The filter drainage system will be constructed using fine and coarse aggregate material. This type of filter drainage has been used successfully on most waste impoundments on the Copperbelt, particularly tailings dumps and is relatively simple to construct and maintain. Considering the trucks that will be used for transporting the slag material, this preferred design allows for the trucks to overrun the filter alignment with minimal disintegration of the filter material.

Alternative under-drainage systems use synthetic drainage liner materials which for the type of dumping selected are not suitable. Liner drainage systems require the foundation to be of high strength and not susceptible to deformations. The proposed site is a tailings reclamation site with the underlying material prone to local deformations. The limiting foundation strength as well as the high cost of synthetic drainage liner material makes this alternative unsuitable.

4.4 Alternative Technology

The alternative technologies considered relate to dumping of either granulated slag or molten slag.

Granulated Slag

Molten slag from the smelting process is directed into a water granulation system. The resulting slag granules with a moisture content of 10 – 14 per cent are loaded into dump trucks. The slag will be transported to the proposed project site using the existing access road. The slag will be end-tipped from the dump truck at the dump site.

Molten Slag

Molten slag from the smelting process will be loaded into rail cars and transported to the proposed project site. The slag will be dumped at the site in its molten state (semi-solid). The slag has to be maintained in its molten state from the Smelter to the dump site and therefore it will be very hot.

The use of rail cars will require construction and installation of a railway system from the Smelter to the Slag Dump Site. In addition, a new molten slag waste handling facility will have

to be constructed at the smelter plant where molten slag material will tapped from the a holding furnace and onto the rail cars.

Safety is a major concern as the material is transported while it is very hot in a molten state. Any accidental spillage of the molten slag along the railway route could result in serious consequences such as injuries, fatalities and possible damage to property.

Because of the relatively long distance, the slag will solidify and could make dumping of slag a challenge.

Therefore, the preferred alternative is dumping of granulated slag because slag granules at normal temperature will transported and dumped at the project site. There will be no need for construction of a new access road to the project site as the existing one will be used. The preferred alternative is implementable at relatively lower costs because construction of transportation route will be required.

Raw Material Alternatives

The raw materials required for preparing the dumping site includes the following;

- Fine aggregate material for the filter drains;
- Coarse aggregate material for the filter drains;
- Construction aggregate for the construction of a filter drain collection sump; and
- Earth-fill material for widening the access road and formation of an access road surface over the tailings material.

There are no other raw material requirements for the dump as the site, which is a brownfield will only require levelling and the construction of an under-drainage system.

During dumping operations, no other raw material will be used, apart from the slag material itself. Despite the slag material being the waste being dumped it is considered a raw material as it forms the outer confining walls of the dump.

4.5 The “No Action” or “No Project alternative”

Under the “No Projective Alternative”, any potential adverse environmental and social impacts associated with the project would not occur. However, the assessment indicates that the disadvantages with the no project scenario include the following:

- Significant reduction in copper production since there will be limited space for slag disposal, a process directly connected to the operations of the smelter;
- Loss of employment for people working at the smelter and associated plant facilities as the smelter will have to be shut if no dumping place is made available;
- Loss of government revenue through reduced taxes arising from reduced copper production; and
- Loss of business for suppliers and contractors directly and indirectly dependent on the operations of the smelter.

5 ESIA METHODOLOGY

5.1 Approach to Assessment

The ESIA process undertaken for the proposed project involved assessment of the environmental and social impacts associated with the Project. The assessment has addressed potential impacts from construction, operation and decommissioning phases of the Project. Potential receptors of impacts have been identified from baseline data, with an assessment of the significance of potential impacts on these receptors undertaken.

Primary baseline data has been gathered through surveys conducted within and around the project area. The primary data has been supplemented with secondary data, where available. The environmental and social impacts that may potentially arise as a result of the proposed project have been assessed against the baseline conditions established through surveys and secondary data.

The Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No. 28 of 1997) informed the ESIA process undertaken to carry out the study and to prepare the Environmental and Social Impact Statement. Reference was also made to the World Bank Group's International Finance Corporation (IFC) Performance Standards, it's supporting applicable IFC Environment Health and Safety (EHS) Guidelines, Vedanta Sustainability Framework and other general international industry best practices.

The general approach adopted in preparing this ESIS for the proposed project included the following:

- Gathering available environmental and social baseline data;
- Analysis of the proposed project with regard to potential impacts and risks during its implementation;
- Identification of environmental and social mitigation strategies;
- Prediction and assessment of impacts in terms of their intensity, significance and duration;
- Recommendations for environmental management and monitoring;
- Development of a conceptual decommissioning and closure plan;
- Estimation of the closure cost; and
- Collation of the above information into the ESIS.

A detailed approach to the ESIA study is presented in the Terms of Reference (Appendix A). The environmental and social baseline conditions of the project area relating to ambient air quality, water resources, soils and land use, noise and vibration, flora and fauna, traffic, archaeology and cultural heritage, radiation and socio-economics have been established and are presented in Section 6 of this document.

5.2 Public Consultations

Public consultation is an integral part of the overall environmental and social impact assessment process. It is an important tool used for management of a two-way communication between a project sponsor and the public. Public consultation brings out among other important issues better information on local environmental and socio-economic

issues of concerns that may arise from proposed projects. In addition, it can produce better ideas on issues and/or alternatives that may not have been previously considered by project proponents.

International corporations such as the International Finance Corporation (IFC) have adopted policy and procedural requirements regarding public consultation and disclosure. The IFC requirements are designed to ensure that IFC financed projects are implemented in an environmentally and socially responsible manner (IFC, 1998). Some operational policies on environmental assessment (IFC Operational Policies - Environmental Assessment, OP 4.01) specifically requires a Project sponsor to conduct meaningful consultations with relevant stakeholders including affected groups and other interested parties.

In addition, IFC requires that material relevant to a project be disclosed and provided to the project affected people and other interested groups. This should be carried out in a timely manner and in a language understandable and accessible to the groups being consulted (IFC, 1998).

The Environmental Management Act No.12 of 2011 provides for public participation in Part VII of the Act. Its subsidiary legislation, the Environmental Impact Assessment Regulations, 1997 also provides for on-going public participation throughout the ESIA process.

In compliance with the Zambian environmental regulations and to conform to international best practices in conducting environmental and social impact assessments, a project scoping meeting was held on 2 October 2013 at Mushishima Primary School in Chingola as part of public consultation. The meeting was held to explain to stakeholders the nature of the proposed New Slag Dump project, to gather their input concerning key environmental and social issues that need to be addressed in the ESIA study and to identify major environmental and social concerns. The minutes of the meeting are included in the Terms of Reference (Appendix A).

Project information on alternatives, anticipated impacts, proposed mitigation measures, among others, was presented in English and translated in the local language (Bemba) well understood by the local communities. The stakeholders provided feedback and suggestions on project information presented. The stakeholders were drawn from Konkola Copper Mines Plc, Zesco, Mulonga Water and Sewerage Company, URS Scott Wilson Zambia, Chingola Municipal Council, Mushishima community, Katunga Bulungu Community, Kafue Hippo Pool Community, Helen/Kansenji Community and Mulenda Farm Community. The stakeholders were informed about the meeting through different modes of communication that included:

- Adverts in the daily newspapers (Times of Zambia, Daily Mail and Post Newspaper);
- Announcement on the local community station (Radio Icengelo);
- Announcements using Public Address System;
- Physical visitation of stakeholders (direct invitation).

The stakeholders helped to determine the scope of the work to be carried out when preparing the ESIA report by contributing and raising their concerns on the proposed project. The views and concerns of the stakeholders, where appropriate, were taken into account in developing the Terms of Reference and in undertaking the studies. The issues and concerns that were raised by the stakeholders relate to air pollution, surface and ground water pollution, radiation arising from processing foreign concentrates containing uranium, potential increase in

incidences of criminal trespass, theft and vandalism. These issues and concerns have been addressed in Section 6.

A public disclosure meeting to disclose the contents of the draft ESIS and to have further public input in preparing the document was held on 22nd August 2014 at Mushishima Primary School. The minutes of the meeting are included in Appendix J of this report. The key issues raised are included in Table 5.1 below:

Table 5.1: Key Issues raised at the Public Disclosure Meeting

Key Issues / Questions	Response / How issue will be addressed
Safety of existing access road users	No new access roads would be constructed. Safety measures would be implemented on the existing road to TD2 operations to guarantee community safety.
What will be done about the acid from the slag material as it will affect our health?	The slag material is inert and does not produce any acid fumes.
Whether new access road will be constructed to the slag dump	The current road being used to access TD2 will be used, but will be widened
Safety measures to be placed on the access road	The road will be widened. Speed limiters and signage will be installed at every identified risk points such as road crossways on T3 and T5. Haulage road will be restricted to authorised KCM or contractors vehicles.
Safety measures to be placed on the access road	Safety signage will be installed on the highway
Security checks around the proposed new Slag Dump	The security checks are done to ensure protection of lives and property for both company and community assets.
Access road to the slag dump	The current access road being used to access TD2 will be used but will be widened.
Research into potential reuse of slag material	A lot of research on the slag material has been undertaken and any other research in this area is welcome.
Potential fence failures	The fence is meant to restrict access and therefore there would no immediate community health risks, however, this would be repaired in the shortest possible time should it collapse
Potential water pollution in streams	The slag dump has a sump with adequate capacity to store runoff effluent. KCM will ensure that within minimal time, the malfunctioning pump is repaired.

Other consultations were carried out during baseline surveys prior to holding the public disclosure meeting. A list of people consulted during the socio-economic baseline surveys is included in Section 6.

5.3 Impact Identification, Assessment and Mitigation Measures

The potential impacts of the proposed Project have been identified and assessed based on the review of project description and critical assessment of the project components in relation to the prevailing environmental and social baseline conditions. The identification and

assessment of potential impacts was also based on applicable national legislations and design guidelines for the slag dump.

A standard impact assessment methodology was applied on identified impacts and took into account the nature[1] or status of the predicted impact, extent of the impact[2], magnitude or intensity[3] of the impact, the duration[4] of the impact and the probability[5] of the impact occurring. The impacts were given a rating using the assessment criteria as indicated in Table 5.1. The overall significance of the impact was obtained based on the extent (E), duration (D), intensity (I) and probability of the impact (P) occurring.

Significance of predicted impact (S) = (E + D + I) x P

The impact assessment terminology and ratings used to describe the impacts are presented in Table 5.1.

The ESIS include a description of mitigation measures aimed at enhancing beneficial impacts and avoiding, reducing, remediating or compensating significant adverse impacts.

[1] Nature of impact – an appraisal of the type of effect an activity would have on the affected environment.
[2] Extent of the impact – indicates whether the impact will be site specific, local, regional, national or international.
[3] Magnitude or intensity of the impact – indicates whether the impact is destructive or benign.
[4] Duration of the impact – indicates the lifetime of the impact as either short-term, medium-term and long-term.
[5] Probability of the impact – describes the likelihood of the impact actually occurring.

Table 5.1: Impact Assessment Terminology and Ratings to be used in determining significance		
Assessment Terminology		**Ratings Used for determining significance**
Nature of predicted impacts (N)		
Neutral	No impact on the environment	0
Negative	Adverse impact on the environment	-
Positive	Beneficial impact on the environment	+1
Duration of predicted impact (D)		
Short term	An impact that persists for 0 - 5 years	1
Medium term	An impact that persists for between 5 - 15 years.	2
Long term	An impact that will cease after the operation life of the project.	3
Permanent	No mitigation will occur (Permanent feature)	4
Extent of the impact (E)		
Site specific	Impact within the boundaries of the site	1
Local	Impact within an area of 5 km of the site	2
Regional	Impact within the Copperbelt Province	3
National	Impact on national scale	4
Intensity of the impact (I)		
Low	Impact affects the environment in such a way that no natural, cultural and social functions and processes are affected.	1
Medium	Where the affected environment is altered but natural, cultural and social functions and processes continue, albeit in a modified way.	2
High	Natural, cultural or social functions and processes are altered to the extent that they will temporarily cease.	3
Very high	Natural, cultural or social functions and processes are altered to the extent that they will permanently cease.	4
Probability of impact (P)		
Improbable	The possibility of the impact to materialise is very low.	2
Probable	There is a distinct possibility that the impact will occur.	4

Table 5.1: Impact Assessment Terminology and Ratings to be used in determining significance		
Assessment Terminology		**Ratings Used for determining significance**
Highly probable	It is most likely the impact will occur.	6
Definite	The impact will occur regardless of any prevention or corrective actions.	8
Significance of predicted impact (S) = (E + D + I) x P		
High	An impact that is capable of causing sufficient change in the environment and fundamentally affect the status, potential productivity or usage of the environment.	> 50
Medium	An impact that is capable of causing change in the environment but does not fundamentally affect the status, potential productivity or usage of the environment.	25 - 50
Low	An impact which is either too small to be measured or does not give rise to any material change in the environment.	< 25

6 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS OF THE PROJECT SITE

The section presents the environmental and social baseline conditions of the project area. It presents information on the topography, climate, geology and seismic characterisation of the project area. It further presents baseline information and data on water quality, air quality, soil and land use, flora and fauna, archaeology and cultural heritage site, traffic volume, noise, radiation and socio-economics. Assessment and evaluation of potential impacts on the baseline environmental and social conditions is presented in Section 7.

6.1 Topography

The project site is in the Copperbelt region. The topography of the region is gently undulating with elevations ranging from 1250 to 1400 metres above sea level (masl). The site is within the Nchanga Mine, which lies on a plateau with an average elevation of 1300 masl. The local topography of the mine area has been significantly modified by overburden dumps and tailings storage facilities that have been created within the mine license area through historical and current mining activities. The dumps have higher elevations in relation to the natural ground while the open pits have created depressions.

The proposed project site is located within a reclaimed TD2 tailings storage facility with an average elevation of 1300 masl and with a gentle fall in elevations towards the Mushishima and Chingola Streams.

6.2 Climate

The climate of the Project area is characterized by three distinct seasons: a rainy season from November to April; a cool and dry season from May to August; and a hot and dry season from September to October.

Mean maximum air temperatures of about 26˚C are recorded in June while mean maximum temperatures of about 33˚C are recorded in October. Extreme air temperatures as high as 37˚C are recorded in September and October on very hot days.

Mean minimum air temperatures range from 03˚C in June to 18˚C in December to February. Extremely low air temperatures as low as -1.6˚C on a very cold day are normally recorded in June and July.

The project area is situated in a high rainfall area. The annual average rainfall, based on long standing records at Kafironda Weather Station in Mufulira located about 35 km South-east of Chingola, is in the order of 1400 mm, with most of rainfall concentrated over the period from November to March. Evaporation exceeds rainfall for two thirds of the year. This typically occurs from April to November.

The prevailing wind direction is predominantly from the northeast to southwest. The average wind speed range from 1.4 m/sec in the summer months to 1.0 m/sec in winter.

Relative Humidity is on the higher side in the rainy season. It reaches its peak around February with the daily average of 82%. It is low around September to October with the daily average of 41% in the atmosphere.

The mean monthly sun shine hours ranged from 4.1 hours to 10.9 hours. The average monthly sun shine hours are 7.7 hours. Table 6.0 below shows mean monthly sunshine hours from March 2008 to April 2013.

Table 6.0: Mean Monthly Sunshine hours from March 2008 to April 2013

Month / Year	Mean Sunshine Hrs
Jan-08	-
Feb-08	-
Mar-08	7.4
Apr-08	9.3
May-08	9.7
Jun-08	9
Jul-08	8.3
Aug-08	10.2
Sep-08	10.3
Oct-08	-
Nov-08	5.4
Dec-08	4.9

Month / Year	Mean Sunshine Hrs
Jan-09	5.1
Feb-09	-
Mar-09	-
Apr-09	-
May-09	8.6
Jun-09	9.4
Jul-09	8.3
Aug-09	10.2
Sep-09	
Oct-09	
Nov-09	5.8
Dec-09	4.9

Month / Year	Mean Sunshine Hrs
Jan-10	5
Feb-10	4.7
Mar-10	6
Apr-10	8.4
May-10	9.8
Jun-10	9.1
Jul-10	8.4
Aug-10	9.8
Sep-10	10.2
Oct-10	10.9
Nov-10	7.2
Dec-10	4.2

Month / Year	Mean Sunshine Hrs
Jan-11	4.6
Feb-11	5.9
Mar-11	5.7
Apr-11	9.3
May-11	9.2
Jun-11	8.9
Jul-11	9.5
Aug-11	10.2
Sep-11	9.6
Oct-11	7.8
Nov-11	6.1
Dec-11	5.3

Month / Year	Mean Sunshine Hrs
Jan-12	4.1
Feb-12	5.7
Mar-12	4.9
Apr-12	8.2
May-12	9.4
Jun-12	9.1
Jul-12	9.4
Aug-12	9
Sep-12	9.2
Oct-12	10.3
Nov-12	7.4
Dec-12	5.3

Month / Year	Mean Sunshine Hrs
Jan-13	4.7
Feb-13	5
Mar-13	4.9
Apr-13	9.5

Source: Extracted from Climatological Weather Summary Report for the period 2000 to 2014 January, Kafironda Agro-meteorological Station, 2014 January.

6.3 Geology

The geology of the Nchanga Mining License consists of two major rock units, namely the Basement Complex and the Katanga System. The Basement Complex is overlain by the Katanga System, which is divided into the Roan, Mwashia, and Kundelungu groups and includes quarzites, argillites, dolomites, limestones, shales, and sandstones as the main rock types (Amec, 2001).

Mineralisation at the Nchanga Mine exists in two main horizons, namely the Upper and Lower ore bodies. Generally, the underground operations extract ore from the Lower Orebody while open pit mining operations extract ore from one orebody or both where they exist. There are also significant satellite orebodies along the strike length, some of which have appreciable exploration potential. The orebodies are dispersed along the 40 km of strike in the Lower Roan Group strata that are folded into the major north-westerly plunging asymmetrical synclines and anticlines draped around a hub of red granite. The three principle structural elements are the Nchanga Syncline, the Chingola Anticline, and the Mimbula-Chabanyama Syncline.

The Lower Orebody is one of the sources of ore at Nchanga Mine. The orebody contains mixed oxide/sulphide mineralisation mainly in carbonaceous shale but transgressing down through a transition zone of evaporitic origin into coarse arkose. The copper ore in this orebody mainly occurs as malachite, chalcopyrite and bornite.

The Upper Orebody, which is a feldspathic quartzite and a basal portion of the Upper Banded Shale some 40 m stratigraphically above the Lower Orebody, is the other source of ore at the mine. It is contained within the southern limb of the Nchanga Syncline and is underlain by the Lower Orebody. The Upper Orebody is the main source of ore in the open pits and the most common minerals are oxides (mainly malachite) and sulphides (chalcopyrite and bornite). Some chrysocolla, cuprite, cupriferous wad and azurite are also common (Amec, 2001).

6.4 Seismic Site Characterisation of TD2 Project Site

The seismic site characterization of the TD2 project was established through the explosion refraction seismic survey conducted at the project site (DN Consulting Associates, 2014) (see Appendix I(a) for the Seismic Refraction Survey Report on TD2 – proposed site for the New Slag Dump). A geological section line (NW-SE) taken through the interpretation map shown in Figure 6.1 was considered and the following conclusions have been drawn for TD2 engineering site:

(i) The crust beneath the site dips towards the north-western region of the site having low surface ground elevations and has raised lithological thicknesses on the south-eastern region where higher surface elevation values have been observed.

(ii) The compressional rates of propagation of seismic energy have shown gradational increases from the north-western end to the south-eastern flank. This observation is explained when considerations of the burial thicknesses evaluated from the explosion refraction seismic measurements of the site are taken into account. The crustal thicknesses as evaluated from the two-dimensional velocity structures of the experiment show gradual increases from thin north-western stratigraphy to thicker south-eastern lithologies which are occupied by layers of competent rock units.

(iii) The competent rock units of the north-western flanks show intrusions of deep seated faults and fractured/weathered zones as compared to the south-eastern competent rock units which have only mapped these deformations in shallow depths.

Based on the above observations it can be concluded that the refraction seismic measurement of the TD2 engineering site has characterized much more stable rock units towards the south-eastern region of the engineering site than has been observed towards the north-western end of line NWSE shown in the interpretation map (See Figure 6.1).

As a necessary consequence of the premises of the proposition of the explosion refraction seismic technique to the TD2 engineering project, the geological data listed below has been gleaned through the refractory seismic survey conducted at the site:

(i) subsurface seismic layer velocity information which is dependent upon the elastic properties of the subsurface geology; and

(ii) depth to geological stratigraphy.

The primary geological information obtained on TD2 site can be used in a number of applications. These applications would include estimation of hydraulic conductivity for modelling contaminant transport zones that would avoid seepages of discharge to the environment. Engineering structure stability considerations are also adequately covered by the primary geological data obtained which has been reported on bedrock topography and has also mapped faults and fractured zones of the project site.

Rippability concerns regarding the engineering site may also be evaluated by engaging this new geological data of the site when seismic layer velocities are considered in connection with the elastic material properties of the geological material at the site (DN Consulting Associates, 2014).

6.5 Water Resources and Quality Baseline Conditions

6.5.1 Scope and Methodology

The immediate catchment area within which the project site falls formed the study area for the water resources baseline survey. This included mainly the Mushishima and Chingola Streams and the Kafue River. Groundwater boreholes and wells in the vicinity of the project site were also included in the scope.

The survey was conducted in the project area to establish the water resources potentially at risk of being adversely affected by the proposed project.

The identification of potential impacts that may arise as a result of the project included determining the type of changes that may potentially occur on water resources. These included the following:

- Changes in the quality of surface water in nearby streams and river considered to be sensitive receptors;
- Changes in the quality of groundwater in the project area as a result of the proposed project.

A methodology used to gather baseline data on water resources and quality included review of available and baseline surveys, which included sampling and analysis of samples nearby Mushishima and Chingola Streams and Kafue River. The detailed methodology adopted is presented in Appendix H.

6.5.2 Baseline Conditions

Surface Water Hydrology

The Copperbelt region's surface waters are drained into the Kafue River, either directly or via a well-developed dendritic drainage pattern formed by its tributary streams and rivers.

The project site lies within the Kafue River drainage system with the Chingola and Mushishima Streams being the nearest and most important hydrological features in relation to being the potential receptors of runoff from the proposed Slag Dump. The Chingola steam flows into the Mushishima Stream, which flows into the Kafue River. The proposed project site is drained by the Mushishima and Chingola streams. It is within the catchment area of Chingola and Mushishima Streams.

Surface Water Quality

KCM has a surface water quality monitoring programme in place which includes routine sampling and analyses of water samples sampled from nearby streams and effluent discharges from mine area. Figure 6.2 shows the location of the sampling points.

The aim of the monitoring programme is to record the quality of effluent being discharged to the environment and to monitor compliance with effluent standards and permit limits as stipulated in the Zambia Environmental Management (Licensing) Regulations, 2013 and license conditions issued under the same regulations. The results that do not meet the standards are investigated as a matter of routine.

Surface water monitoring stations are distributed throughout the mine area but the relevant stations in relation to the proposed project area are located on the Mushishima and Chingola Streams. These are:

- Mushishima Stream at TD3/4 Road Bridge;
- Mushishima Stream at Solwezi Bridge
- Chingola Downstream;
- PCD Spillway
- Mushishima Downstream
- Chingola Upstream;
- Kafue River at Hippo Pool;
- Chingola Upstream.

In addition, effluent from the existing slag dump is monitored. The effluent flows from the base of the dump and is discharged into a drain that flows into the Pollution Control Dam (PCD). Water samples are collected from these streams and effluent drains and are analysed for the following parameters:

- pH
- Total Suspended Solids (TSS);
- Total Dissolved Solids (TDS);
- Dissolved Cobalt (DCo);
- Total Cobalt (TCo)
- Dissolved Manganese (DMn);

- Electrical Conductivity (EC);
- Dissolved Copper (DCu);
- Total Copper (TCu);
- Dissolved Iron (DFe);
- Total Iron (TFe);
- Total Manganese (TMn);
- Dissolved Calcium (DCa);
- Dissolved Magnesium (DMg);
- Dissolved Sulphate (DSO4).

The quality of effluent from the existing slag dump as monitored between August 2010 and May 2014 is shown in Table 6.2 and indicates that the quality is within the Environmental Management (Licensing) Regulation, 2013 (Statutory Instrument No. 112 of 2013) effluent and wastewater discharge limits.

The background surface water quality in the Mushishima and Chingola Streams as well as the Kafue River at Hippo Pool was monitored in May 2014 as part of the Environmental and Social Impact Assessment study of the proposed project. The sampling points and their geographical coordinates are presented in Table 6.1. The samples were analysed for Co, Cu, Fe, Mg, Na, Ni, Pb, Zn, K, Mn, Carbonates, pH, Chlorides, Nitrates, Phosphates, Sulphates, TDS, TSS and EC. The results are shown in Table 6.3.

With respect to the parameters analysed, the results indicate that the water quality is generally good and is within the effluent and wastewater discharge limits provided in the Environmental Management (Licensing) Regulations, 2013 except for TSS in the sample collected upstream of Chingola Stream. Effluent discharges from a nearby car wash and industries are also discharged into the Chingola Stream and this contributed to high suspended solids observed during the site visit.

Table 6.1 Geographical Coordinates showing the location of Sampling Points

No.	Sampling Point	Elevation	Coordinates
1	Solwezi River Bridge at Mushishima Stream (Upstream of the Site)	1236 m	35 L 0586183 UT 8614064
2	TD3 Crossing at Mushishima Stream (Downstream of proposed site)	1264 m	35 L 0586181 UT 8614064
3	Hellen Bridge Crossing at Mushishima Stream (Downstream of the proposed Site)	1262 m	35 L 0588278 UT 8616998
4	Hippo Pool at Kafue River (Downstream of the proposed site)	1248 m	35 L 0592477 UT 8622203
5	Chingola Upstream (Upstream of the proposed site)	1316 m	35 L 0592214 UT 8613468

Table 6.2: Nchanga Smelter Slag Dump Environmental Effluent Results: August 2010 - May 2014												
Month	Parameters Monitored											
	pH	TCu	DCu	TFe	DFe	TMn	DMn	TCo	DCo	EC	TSS	TDS
Aug-10	7.68	0.25	<0.01	1.32	<0.01	1.02	0.81	<0.01	<0.01	1250	32	1200
Sep-10	8.21	0.89	0.14	1.06	1.06	<0.01	0.06	<0.01	<0.01	1426	15	458
Oct-10	7.98	1.03	<0.01	<0.1	0.03	<0.01	<0.01	1.06	1.32	850	19	761
Nov-10	8.01	1.6	<0.01	<0.1	0.17	<0.01	<0.01	<0.01	0.62	1024	12	943
Dec-10	8.42	0.45	<0.01	0.25	<0.01	<0.01	0.25	<0.01	0.12	1605	17	253
Jan-11	8.07	3.5	1.08	3.67	<0.01	<0.01	<0.01	<0.01	<0.01	640	10	448
Feb-11	8.47	0.51	<0.01	1.36	0.12	0.08	<0.01	0.12	0.11	734	60	514
Mar-11	8.55	1.04	<0.01	1.91	<0.01	<0.01	<0.01	<0.01	<0.01	1464	15	1025
Apr-11	8.36	0.62	<0.01	<0.01	1.34	<0.01	<0.01	<0.01	<0.01	1050	25	1500
May-11	7.91	0.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1625	63	325
Jun-11	8.03	0.92	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	568	45	618
Jul-11	8.51	1.2	<0.01	0.16	<0.01	0.16	<0.01	<0.01	<0.01	841	13	796
Aug-11	7.45	0.78	<0.01	0.44	0.18	0.44	<0.01	<0.01	<0.01	1324	16	1025
Sep-11	7.6	0.84	<0.01	<0.01	0.13	<0.01	<0.01	<0.01	<0.01	968	12	1600
Oct-11	8.14	0.67	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1436	78	845
Nov-11	8	1.32	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	630	54	756
Dec-11	8.06	0.96	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	561	26	445
Jan-12	8.25	0.51	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	754	15	621
Feb-12	7.06	0.86	<0.01	0.12	<0.01	0.12	<0.01	<0.01	<0.01	1023	14	530
Mar-12	7.36	1.4	<0.01	1.45	<0.01	1.45	<0.01	<0.01	<0.01	1576	28	452
Apr-12	8.32	0.93	0.12	<0.01	0.12	<0.1	<0.01	<0.01	<0.01	962	7	946
May-12	8.04	1.26	0.11	<0.01	1.25	<0.1	<0.01	<0.01	<0.01	856	5	861
Jun-12	8.52	0.74	<0.1	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01	958	9	1300
Jul-12	8.06	<0.01	0.13	0.73	0.21	0.23	<0.01	5.76	3.5	534	6	28
Aug-12	7.38	0.12	<0.1	0.103	<0.01	0.266	0.106	0.104	<0.01	625	34	406
Sep-12	6.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	939	5	508
Oct-12	8.07	<0.01	<0.01	0.1246	<0.01	<0.01	<0.01	0.5138	0.5282	936	14	93
Nov-12	7.67	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.8355	0.5426	961	8	987
Dec-12	6.14	0.11	<0.01	<0.01	<0.01	0.1	<0.01	1.21	<0.01	692	27	785

Table 6.2: Nchanga Smelter Slag Dump Environmental Effluent Results: August 2010 - May 2014												
Month	Parameters Monitored											
	pH	TCu	DCu	TFe	DFe	TMn	DMn	TCo	DCo	EC	TSS	TDS
Jan-13	7.3	0.25	0.182	<0.01	1.019	<0.01	1.12	<0.01	1.018	891	24	624
Feb-13	7.5	0.76	<0.01	11.2	<0.01	0.07	0.16	0.192	0.189	1910	19	689
Mar-13	8.1	1.26	0.16	0.19	<0.01	<0.01	<0.01	<0.01	1.2	1232	25	542
Apr-13	8.12	0.84	0.2	0.84	<0.01	<0.01	0.19	<0.01	<0.01	914	16	875
May-13	8.01	<0.01	1.83	0.171	<0.01	0.13	<0.01	0.17	<0.01	819	9	824
Jun-13	8.2	0.71	0.94	1.85	0.7	0.08	<0.01	<0.01	1.06	819	15	1001
Jul-13	8.13	0.17	0.13	<0.01	0.33	<0.01	<0.01	0.101	0.98	1206	16	302
Aug-13	7.22	0.14	0.87	0.14	0.76	<0.01	1.17	<0.01	0.91	795	39	409
Sep-13	6.26	0.13	<0.01	0.96	0.95	0.192	<0.01	<0.01	0.36	1984	11	602
Oct-13	8.3	0.64	<0.01	0.887	0.82	<0.01	<0.01	<0.01	<0.01	895	25	100
Nov-13	7.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1926	56	847
Dec-13	8.16	<0.01	<0.01	<0.01	<0.01	<0.01	1.61	<0.01	<0.01	1712	31	725
Jan-14	8.71	0.42	<0.01	1.16	0.173	0.109	<0.01	<0.01	<0.01	695	19	725
Feb-14	8.25	0.79	0.17	<0.01	0.61	<0.01	<0.01	<0.01	<0.01	1172	24	680
Mar-14	6.4	1.29	0.13	<0.01	0.11	<0.01	<0.01	0.19	0.93	1324	22	382
Apr-14	8.12	0.715	0.19	<0.01	0.19	0.18	<0.01	<0.01	<0.01	895	27	873
May-14	7.9	1.18	<0.1	0.12	1.18	0.13	<0.01	<0.01	0.328	871	17	953
Statutory Limits (SI 112 of 2013)	**6.0-9.0**	**1.5**	**2.0**	**2.0**	**2.0**	**1.0**	**2.0**	**1.0**	**2.0**	**4300**	**100**	**3000**

NB: *All results except pH and conductivity are in mg/l. Conductivity is in micro-Siemens per centimetre (µS/cm. All Results are monthly average figures*.

Source: KCM Nchanga Slag Dump Environmental Effluent Monitoring Results (2014).

Table 6.3: Background Surface Water Quality Results								
Parameter	Unit	Solwezi Road Bridge at Mushishima Stream	TD3 Crossing at Mushishima Stream	Hellen Bridge Crossing	Hippo Pool at Kafue River	Chingola Stream Confluence (Chingola Upstream)	Zambian Drinking Water Standards	Effluent Discharge Limits into Aquatic Environment)
pH	pH	7.71	7.22	7.37	7.53	7.2	6.5 – 8.0	6.0 – 9.0
Electrical Conductivity	µS/cm	151.8	175.9	521	140	294.2		4300
Total Dissolved Solids	mg/L	76	88	260	70	146	1500	3000
Total Suspended Solids	mg/L	10	4	16	8	698		100
Carbonates ($C0_3^{2-}$)	mg/L	<1.2	<1.2	<1.2	<1.2	<1.2	500	-
Nitrates	mg/L	<0.07	<0.07	0.87	0.08	8.91	10	50
Dissolved Sulphates	mg/L	<3.1	<3.1	<3.1	<3.1	<3.1	400	1500
Potassium	mg/L	1.1	1.2	3.7	0.7	6.4		-
Chlorides	mg/L	<1.2	<1.2	<1.2	<1.2	<1.2	250	800
Iron	mg/L	0.31	0.19	0.05	0.12	0.03	1.0	2.0
Copper	mg/L	<0.001	<0.001	0.02	0.05	0.04	1.0	1.5
Cobalt	mg/L	<0.001	<0.001	0.003	0.024	0.11	0.5	1.0
Manganese	mg/L	<0.01	0.02	0.18	0.02	0.15	0.1	1.0
Magnesium	mg/L	10.54	11.08	18.66	7.59	11.61	150	500
Sodium	mg/L	2.6	2.9	4.2	3	9.5		-
Zinc	mg/L	0.006	<0.06	<0.006	<0.06	0.019	5	10
Nickel	mg/L	<0.002	<0.02	<0.002	<0.001	0.005		0.5
Phosphorous($P0_4$-P mg/l)	mg/L	0.6	1.1	0.3	0.6	0.8		6
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	0.5

The seismic refractory survey conducted on TD2 Slag Dump Project Site revealed that the competent rock units of the north-western flanks of the project site have intrusions of deep seated faults and fractured/weathered zones as compared to the south-eastern competent rock units which have only mapped these deformations in shallow depths (DN Consulting, 2014). The deep seated faults and fractured / weather zones are potential high-permeability geological features through which seepage from the Slag Dump can be transported into the groundwater regime.

The slag leachability tests were also conducted as part of the environmental and social impact assessment study. A slag sample obtained from the existing Slag Dump at KCM was agitated with tap water for 24 hrs. Following agitation, the sample was left standing for 24 hrs. The pregnant liquor solution (PLS) was analysed for copper. The analytical results are presented in Table6.4 and indicate that the slag did not show potential to be leached for the duration of exposure in tap water. The copper content in both water and the filtrate was below 10 milligrams per litre (mgpl). It (slag) however showed potential to be leached when in contact with a dilute acid that had acid strength of 5 grammes per litre (gpl).

Therefore, surface runoff and seepage water from the Slag Dump is not likely to be contaminated with heavy metals. In addition, potential seepage through the faults and fractured zone on the north-western flank of TD2 is not likely to be contaminated. Hence, potential contamination of surface water in the project area through discharge of surface runoff to receiving water bodies is considered to be low. Furthermore, potential contamination of groundwater through seepage of water from the Slag Dump into the groundwater regime is also considered to be low.

Table 6.4: Leachability Results of Nchanga Slag

Sample ID Type	Sulphuric Acid Strength (gpL)	Feed Grade		Initial pH	Final pH	PLS
		%TCu	%AsCu			
Water	0	0	0	7.64	-	<10
Slag	0	0.53	28	7.71	8.24	<10
Slag	5	0.53	28	3.49	3.64	220

Source: Leachability Test Results, AHK, 2014.

Groundwater Hydrogeology

The groundwater regime within the Nchanga Mining License Area has significantly been altered because of underground and open pit mining activities. An evaluation of the level of the water table at the TD2 project site based on the seismic refractory survey undertaken as part of the ESIA study has revealed a water level in the range of approximately 15 – 40 m below the surface (DN Consulting Associates, 2014; Appendix I(b)).

The explosion seismic data obtained during the seismic refractory survey has further revealed that the bedrock surface has a “pyramidal” like structure with a gradual slant of bedrock depths towards the north-west and steep bedrock depths dipping towards the south-east of the project site. The entire bedrock surface shows a NNE-SSW strike. The bedrock is interpreted as relatively impermeable Late Precambrian Katanga sediments and it can be inferred that the north-west and south-east trending structure of the bedrock topography controls the shallow groundwater flow at the site.

Depth to unweathered bedrock shows a variation range of approximately 6 – 53 m below land surface at the TD2 project area. Two bedrock highs have been located in the area: one in the

North-west and the other in the South-east. The two bedrock highs are connected as an elongated oval-like feature extending south-south-westward from directly beneath the central region of the survey project site. This bedrock oval-like feature may be acting as a groundwater divide which allow groundwater to flow both in the north-westerly and south-easterly directions.

Groundwater Quality

The available data on groundwater quality generally indicates that both shallow and deeper Bedrock Aquifer groundwater quality falls within the World Health Organisation Drinking Water Standards. The nearest groundwater monitoring borehole sunk on the north-eastern side of the proposed site has not intercepted water at a depth of 50 metres. This status is attributed to drawdown effect influenced by dewatering of open pits and underground workings at the mine.

At other groundwater monitoring boreholes, groundwater quality is monitored on a monthly basis to provide, among other things, information on shallow groundwater quality and groundwater levels. The only groundwater monitoring borehole, which can be said to have similar conditions as the dried up borehole at TD2, is TD3/4 borehole situated at TD3 over 2 km north-west of the proposed project site. The dump has been reclaimed just like TD2. The available data is presented in Tables 6.5 and 6.5a. Quality of the borehole water generally meets requirements except for the following parameters: Mn, Cr, Cd, Al and Turbidity.

Based on the seismic refraction survey undertaken, it has been inferred that the north-west and south-east trending structure of the bedrock topography controls the shallow groundwater flow at TD2 project site. The bedrock has an oval-like feature which may be acting as a groundwater divide and which will allow potential contaminants to flow both in the north-westerly and south-easterly directions. Therefore, groundwater monitoring wells should be located in these directions as shown in Figure 6.3.

Table 6.5: TD3/4 Groundwater Borehole Analytical Results				
Parameter	**Unit**	**June 2013**	**October, 2013**	**Zambian Drinking Water Standards**
pH	pH	5.34	5.67	6.5 - 8.0
Turbidity	NTU	20	31	10 NTU
Color	Hazen Units	12	0	15 Hazen units
Hardness	mg/L	412	440	500 mg/l
Cu	mg/L	0.21	0.01	1.0 mg/l
F	mg/L	<0.01	<0.01	1.5 mg/l
Fe	mg/L	<0.01	<0.01	1.0 mg/l
Na	mg/L	21.3	39.5	-
Mn	mg/L	0.21	0.07	0.1
Cr	mg/L	0.002	4.43	0.05
Cd	mg/L	0.02	0.01	0.005
Al	mg/L	0.32	0.341	0.2
Pb	mg/L	0.02	<0.01	0.05
Zn	mg/L	0.39	<0.01	5
N03	mg/L	Nil	Nil	10
Cl	mg/L	16.5	10	250
DSO4	mg/L	240	155	400
TDS	mg/L	698	1240	1500
Faecal Coliform		0	0	0
Total Coliform		0	0	0

Source: KCM Borehole Analytical Results, 2013

Table 6.5a: Borehole Analytical Results – TD3/4 (January, 2013)			
Parameter	**Unit**	**Value**	**Zambian Drinking Water Standards**
Dissolved Iron	mg/L	0.09	1.0
Total Manganese	mg/L	0.25	0.1
Dissolved Manganese	mg/L	0.22	0.1
Total Cobalt	mg/L	<0.01	0.5
Dissolved Cobalt	mg/L	<0.01	0.5
Calcium	mg/L	69	200
Magnesium	mg/L	46	150
Dissolved Sulphates	mg/L	256	400
Total Dissolved Solids	mg/L	561	1500
Total Suspended Solids	mg/L	263	-

6.6 Ambient Air Quality

6.6.1 Scope and Methodology

The air quality assessment study considered areas surrounding TD2 that included Kamana Farm, Hellen School, Pollution Control Dam, Mushishima Primary School, Mulenda Dairy Farm and Kalilo Community. These areas were considered as sensitive receptors of potential dust emissions from the proposed construction and operation of the Slag Dump.

Ambient air quality monitoring was conducted on the surrounding areas to establish ambient air quality baseline conditions within the project area and to assess the potential impacts on local air quality prior to project implementation. A multi-gas analyser fitted with an in-built pump to suck air was used to analyse ambient air quality at predetermined sampling points within the surrounding areas. The results were compared with ZEMA and World Bank Ambient Air quality guidelines.

A DustMate instrument for measuring (Total Suspended Particles) TSP, PM2.5 and PM10 particles was used to determine baseline values in the TD2 area and surrounding community.

The general methodology to establish baseline ambient air quality is presented in Appendix C.

6.6.2 Ambient Air Quality Baseline Conditions

Air pollution control and regulation is enforced by ZEMA through the provisions of the Environmental Management (Licencing) Regulations, 2013 (SI No. 112 of 2013). The regulations provide ambient air quality guidelines, which are set out in the Second Schedule of Statutory Instrument No. 112 of 2013. The guidelines are meant to protect human health, animal or plant life and the environment. The regulations give an obligation to the license holder to comply with emission limits prescribed in the Second Schedule of the Regulations. Table 6.6 shows the emission limits for ambient air pollutants.

Table 6.6: Emission limits for Ambient Air Pollutants					
Parameter		Reference Time (Average)		ZEMA Guideline Limit	WHO Guideline Limit (µg/m^3)
1	Sulphur Dioxide (SO_2)		10 minutes	500 µg/m^3	500
			1 hour	350 µg/m^3	-
2	Sulphur Dioxide (SO_2) in combination with Total Suspended Particles (TSP)*[1] and PM10	SO_2	24 hours	125 µg/m^3	125
			6 months	50 µg/m^3	-
		TSP	24 hours	120 µg/m^3	-
			6 months	50µg/m^3	-
		PM_{10}	24 hours	70 µg/m^3	50
3	Respirable particulate matter PM_{10}*[2]	PM_{10}	24 hours	70 µg/m^3	
	Respirable particulate matter $PM_{2.5}$*[3]	$PM_{2.5}$	12 hours	15 µg/m^3	
4	Oxides of nitrogen (NO_x) as nitrogen dioxide (NO_2)	1 hour		400 µg/m^3	200
		24 hours		150 µg/m^3	-
5	Carbon monoxide (CO)	15 minutes		100 µg/m^3	-
		30 minutes		60 mg/m^3	-
		1 hour		30 mg/m^3	-
		8 hours		10 mg/m^3	-
6	Ambient Lead (Pb)	3 months		1.5 µg/m^3	-
		12 months		1.0 µg/m3	-
7	Dust fall	30 days	Residential and light commercial areas.	250 mg/m^2/day	-
			Non-residential and light commercial areas.	500 mg/m^2/day	-
8	Ozone (O_3)	8 hours		120 µg/m^3	100

*1) Total suspended particles (TSP) are particles with diameter less than 45 micrometers (µm).

*2) Respirable particles (PM10) are particles with diameter less than 10 micrometers (µm).

*3) Respirable particles (PM2.5) are particles with diameter less than 2.5 micrometers (µm).

NOTE: Reference times are the 98th percentile averaging times.

Baseline Air Quality

Baseline air quality within the project area has been established through reference to the Ambient Air Quality Measurement Report prepared by Alfred H. Knight Zambia Limited (AHK, 2014) as part of the Environmental and Social Impact Assessment study for the proposed Slag Dump project. The baseline ambient air quality data collected during the survey is shown in Table 6.7.

The main sources of emissions identified at the project site were wind-blown dust from the tailings dump and dust generated by the movement of utility vehicles along the existing access roads. Other sources of emissions and particulates within the broader project area are:

- Smelter (emitting gaseous pollutants and particulates);
- Blasting operations at open pits;
- Hauling of ore along the unpaved surfaces;
- Tailings dumps with exposed surfaces from which wind-blown dust is generated;
- Heavy traffic on T3 and T5 contributing to gaseous emissions and particulates;
- Combustion of fuels mainly firewood, charcoal and other biomass that contribute to PM10 load.

The $PM_{2.5}$, PM_{10} and TSP measurements measured in the communities around TD2 are generally all in compliance with the current emissions limits for ambient air pollutants except for elevated TSP and PM_{10} results recorded at Mulenda farm, which is situated at the edge of TD2. The results at Mulenda are a reflection of the levels that are obtaining very near the source, which is TD2 tailings storage facility. The results at the Police Checkpoint situated at the junction of the Chingola and Solwezi roads are also influenced by the trucks and light vehicles that pass through there. The sulphur dioxide values measured in the surrounding communities are just below the hourly average of 350 $\mu g/m^3$ except for the Police Check point. The construction and operation of the Slag Dump will not be a source of sulphur dioxide in the area.

Table 6.7: Results of the Ambient Air Quality Baseline Survey

Location	TSP ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	O_2 %	CO ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)
Kamana Farm	81.00	3.60	26.97	20.98	<12.5	13.39	319.05
Helen School	60.02	3.25	19.81	21.03	<12.5	45.54	310.71
Mushishima Primary School	89.13	4.61	33.58	21.07	22.5	72.32	289.29
Mulenda Dairy Farm	178.55	9.18	77.59	21.03	17.5	45.54	195.24
Kalilo Community	78.33	3.67	28.24	21.18	<12.5	77.68	166.67
Police Checkpoint	129.79	6.16	40.65	21.06	95	53.57	827.38
SI112 of 2013 - Guideline Limits	**120**	**15**	**70**	**-**	**60000**	**400**	**350**
Reference Time	**24 Hours**	**12 Hours**	**24 Hours**	**-**	**30 min**	**1 hour**	**1 hour**
IFC Guidelines		**50**	**25**			**200**	**125**
IFC Reference Time		**24 Hours**	**24 Hours**			**24 Hours**	**24 Hours**

Source: AHK, 2014 (Ambient Air Quality Survey at TD2 - KCM Nchanga Mine)

The potential sources of significant dust emissions within the project area during implementation of the proposed project are:

- Wind-blown dust from large exposed tailings dump surfaces at the project site, particularly during the dry season;
- Movement of construction equipment and haulage trucks during the construction and operation phases of the project.

Air Dispersion Modelling

The AERMOD dispersion model was used to model air dispersion in the area. . The Aermod model was developed by US Environmental Protection Agency to predict ground concentration of pollutants from point, line, area and volume sources. It was developed to predict pollutant dispersion for up to 50 kilometres from the source. A description of the model is given in the Air Quality Assessment Report presented in Appendix C.

The air dispersion modelling for the proposed project was undertaken based on calculated emissions for an area source, which is the proposed Slag Dump, and a line source, which is for the haulage trucks. The emission calculation basis is established on emission parameters from the two sources. The emission from the Slag Dump is considered for constant wind-blown dust. The modelling scenarios adopted are for 4th highest 24 hourly ground concentration of TSP and PM10.

The modelling considers the emissions that will arise from the deposited slag, which is treated as an area source for modelling purposes. The area source is modelled for wind-blown dust. The initial area of deposition is 5 hectares. The area will eventually reach the maximum area of the dump footprint, which is 40 hectares, in 20 years. The modelling is done at the maximum emissions possible which is at 40 hectares.

The other source of emissions is the dust arising from the movement of haulage trucks to and from the TD2 dumpsite. The dust that will be generated is treated as a volume source for the entire route. The dust generated in this source is driven by the movement of trucks on the road. The modelling considers the number of trips, speed of truck movement and other parameters to come up with emission factors.

The emissions of dust arising from movement of haulage trucks on unpaved roads and wind-blown dust from stock piles are not readily available and are difficult to obtain. A very detailed and extensive work is required to derive the most important variables to determine the emissions. The Environmental Protection Agency (EPA) has over years developed some approaches to get the emission values by deriving some emission factors. Details on emission factors are contained in Appendix C and Emission Factor Guidelines EPA AP42 Section 13.2.2 – Unpaved Roads (US EPA, 2004).

The particle size distribution of the slag is a key parameter that determines the emission factors. When compared with tailings material, slag has very little silt and hence has very low potential for wind-blown dust compared to tailings with high silt content. The slag has only 4% silt compared to 50 % in the tailings material. (See Appendix C for particle size distribution of granulated slag and tailings at the project site). The significance of this is that the slag material is coarse and most of it will not be affected by winds in the area. These are some of the key parameters that determine the emission factors.

Meteorological data and terrain have also been taken into account when modelling air dispersion for the project area. Based on review of wind roses for the whole year (Figure 6.4), the resultant dominant wind is 90^{o}, which implies that mostly the areas to the West of the Dump and the haulage road are the main recipients of any dust generated at the project site. The predominant wind direction for a whole year is from East to West. The wind rose for the dry months (May-October) has a resultant wind which is 104^{o} (Figure 6.5). The area which will be downwind for most of the time is to the West of TD2. During the dry months the predominant wind direction will be from South-east to North-west.

Average number of rain fall days has been estimated at 109 days. This is based on 2007 – 2012 weather records from Kafironda Weather Station located over 40 km South-east of the

project site. This means dust emissions from the road surfaces will be naturally mitigated for most of the rain season. This will result in low dust emissions from road surfaces.

The wind frequency distribution chart presented in Appendix C shows that only 3.3% of the winds are within the 5.4 – 8.8 m/s Wind Class threshold where they can cause wind-blown dust. The chart also shows that for the months from May to October only 4.8% of the winds are within the threshold where they can cause wind-blown dust. The 5.4 m/s Wind Class was for tailings material with a silt range of 50-90%. The slag material with silt content of 4% will not be affected much by these winds. The 5.4 m/s has been established by the EPA study at Hayden Asarco Mine Arizona USA.

Model Results - *Assessment of TSP and PM10 Impacts from the TD2 Slag Dump Project*

PM10 daily maximum ground concentration

The daily PM10 maximum ground is 14.17 µg/m^3 and is below the 24hr guideline 70 µg/m^3. This value occurs just next to the dump. The daily PM10 maximum ground concentration for Mushishima Primary school and other area near the dump considered sensitive receptors is 5 µg/m^3 while the value for Mulenda Farm is at 10 µg/m^3. The reported results are the maximum recorded for a single day. Indications from studies show that dust can be generated from stockpiles when the wind velocity is higher than 5.4m/s. The wind frequency data shows that this type of occurrence is 4.8% of the time. During the rainy season the dust emissions are further curtailed. Therefore, the results presented in this study are the worst kind scenario of the area. The model simulation output is depicted in Figure 6.6. The footprint of the emissions is limited to a small area around the dump.

TSP Daily Maximum Ground Concentration

The daily TSP maximum is 28.11 µg/m^3 and is below the 24hr guideline 120 µg/m^3. This value is just at the dump edge. In areas where there is a nearby community like Mushishima Primary School the highest contribution of source to the ambient air is 8 µg/m^3. The model simulation output is depicted in Figure 6.7.

TSP Annual maximum ground concentration

The highest annual average TSP is 11.83 µg/m^3, projected to be near the Slag Dump site. The annual TSP values areas in the surrounding community are all below the 8 µg/m^3 range and hence the surrounding local communities will not be affected by the operations of the proposed slag dump. The annual model output is depicted in Figure 6.8.

The air dispersion modelling study shows that the impact area for dust emissions is on the West of the dump. This agrees with observed measurements on the West of the dump edge represented by an ambient air quality sampling point at Mulenda Farm. The contribution of the Slag Dump and haulage roads in terms of dust emissions to the ambient air quality in surrounding community nearest to the dump is in the range of 4 µg/m^3 to 9 µg/m^3 PM_{10} and 13 µg/m^3 to16 µg/m^3 TSP in the predominant wind direction (East to West). With these modelled contributions the ambient air quality, in relation to the operations of the proposed slag dump, will be within the emission limits for ambient air pollutants provided in Zambian Environmental Management (Licensing) Regulations, 2013 and will remain safe for the residents on the nearby Mushishima Settlements and the environment. Therefore, potential project impacts, as a result of the proposed operations of the slag dump will be of low significance to the residents and the environment.

6.7 Soils and Land Use

6.7.1 Scope and Methodology

The surface soil conditions within the project area were determined by field observations field observations made during soils and land use baseline surveys conducted in May 2014, sampling and analysis of soils within and around the project area and review of existing baseline data on TD7 Expansion Environmental Project Brief. In addition, land use within the project area was determined through baseline surveys and review of environmental assessment reports relevant to the project area.

Soils sampling and analysis

Soil samples were collected selected sampling points within and around the project area. The samples were analysed for soil pH, texture, cation exchange capacity, Nitrogen and Phosphorus. Figure 6.9 shows the location of the soils sampling points. The description of the sampling points is presented in Table 6.8.

Core ring samples were also collected from the same points. The samples were analysed for bulk density, porosity and water holding capacity analysis. The analysis was done at the Soil Science Department of the School of Agricultural Sciences at the University of Zambia.

Detailed methodology on soils sampling and analysis is presented in Appendix K (Soils and Land Use Assessment Report).

Table 6.8: Soils and Land Use Sampling Location			
Sample Point	**Description of Sampling Pont**	**Coordinate**	**Approximate Elevation**
1	T 5 Road - Entrance to Barefoot Camp	35 L 0587770 UT 8613901	1239 masl
2	T 5 Road - Marshlands, beyond Mushishima bridge crossing	35L 0585945 UT 8614212	1229 masl
3	T5 Road - On other side of road, opposite sampling point No.2	35L 0585977 UT 8614281	1275 masl
4	T 5 Road - Opposite Dairy Farm, adjacent to access road to mine dumps	35L 0588741 UT 8613840	1299 masl
5	West of TD 2 dump site	35L 0588580 UT 8615181	1283 masl
6&7	Area between TD 2 and Mushishima Stream to the north-west end (samples obtained on either side of silt bund)	35L 0588339 UT 8615389	1284 masl
8	Between PCD access road and TD2 pump station (adjacent to power line pole # 9)	35L 0589395 UT 8616447	1289 masl
9	Right of Mushishima Stream (opposite road to PCD, close to old borrow pit)	35L 0588422 UT 8616738	1281 masl
10	Helen Dump Site	35L 0590241 UT 86118273	1296 masl
11	Right Bank of Mushishima River, close to Helen Bridge	35L 05889816 UT 8619339	1295 masl

6.7.2 Baseline Conditions

Soils

The surface soils at the TD2 are generally covered with whitish brown fine to medium grained tailings. The subsoils are principally reddish brown, fine to coarse grained insitu material. Reddish brown, medium to coarse grained lateritic soils, and dark brown and fine grained mixture of tailings and insitu material, graduating into darkish grey insitu material, are found in some places within the proposed site. Further north of the proposed site, there is accumulation of tailings on the soil surface as a result of run-off from TD2 flowing into adjacent areas that

include the catchment of Water Dam 2, Chingola Stream and Pollution Control Dam (URS Scott Wilson, 2011).

Further insight into the soil characterisation was undertaken through soils investigations undertaken within the broader project area. The investigations took into account soil characteristics that included soil texture, moisture holding capacity, soil fertility and porosity. Soil characterisation in terms of soil texture is summarised in Table 6.9. The soils analysis results for chemical and physical parameters are presented in Tables 6.10 and 6.11 respectively.

Soil pH

Soil pH is a useful indicator of the relative acidity or alkalinity of a soil. Soil pH is an important soil property because it affects the chemical, biological, and physical processes of the soil. Soil pH controls the availability of essential nutrients. Under acidic conditions, the availability of nitrogen, phosphorus, sulphur, calcium, magnesium, sodium, and molybdenum is limited.

Biological activity and processes determine the abundance of soil microorganism and plants that will grow in certain soils. Low soil pH condition slows the biological transformation of ammonium to nitrate slows. In addition, high soil pH can indirect disrupt soil texture and aggregation.

For all the sample locations Soil pH ranged from 4.34 to 5.98. The soil pH in the area can therefore be characterised as being very strongly acidic to slightly acidic. The area between the Entrance to Barefoot Camp and the channel to the dump, the marshland area beyond the Mushishima Bridge crossing South of Chingola – Solwezi Road and the area opposite the Mulenda Dairy farm are in a very strongly acidic zone.

The marshland areas on the northern side of the Chingola - Solwezi road and Helen Dump site had soils characterised as strongly acid. The area between the PCD access road and the TD2 pump station had soils with medium acidity. Soils which were slightly acidic are in the area immediately west of existing TD2, Silted area just upstream of TD2 control dyke and downstream area towards Mushishima Stream.

Total Nitrogen in Soils

Nitrogen in plant nutrition is combined with C, H and O to form amino acids, the building blocks of proteins and enzymes. Nitrogen is also part of the chlorophyll molecule and several vitamins and is required for plant dry matter production and the production of proteins in grain crops.

Nitrogen levels in the soils are described to be low if the Total N (%) is less than 0.10, medium if it is between 0.1- 0.2 and high if it is greater than 0.2. The levels of total nitrogen in all the samples were less than 0.10% and were therefore low.

Phosphorous

Phosphorus (P) plays a major role in energy storage and transfer, root growth, crop maturity, straw strength and disease resistance. Soils are said to be deficient in phosphorus if the available P is less than 7 mg / kg soil and are described to be rich in P when available phosphorus is greater than 15 mg / kg soil.

The phosphorous levels in soils sampled ranged from 1.89 mg/kg to 22.30 mg/kg with the highest recorded in the area between the PCD access road and TD2 pumping station. The areas downstream and upstream of the silt trap located to the west of TD2, and between PCD access road and TD2 pumping station had phosphorous levels above 15 mg/kg and can therefore be described as being rich in phosphorous.

The soils which were rich in phosphorous were at the following areas:

- Area between TD2 and Mushishima Stream to the north-west end (on either side of silt bund);
- Area between PCD access road and TD2 pump station (adjacent to power line pole # 9); and
- Area on the right bank of Mushishima Stream (opposite road to PCD, close to old borrow pit).

The following points can be described as being deficient in phosphorous:

- T 5 Road - Marshlands, beyond Mushishima bridge crossing,
- T5 Road - On other side of road, opposite Marshlands, beyond Mushishima bridge crossing; and
- West of TD 2 dump site.

Levels of potassium in soils

The levels of potassium in the soils sampled ranged from 0.03 cmol/kg soil to 0.07 cmol/kg soil with an average of 0.05 cmol/kg.

Other chemical parameters are given in Table 6.10. Table 6.11 shows the physical parameters of the soils sampled around the project area.

Table 6.9 summaries the soils chemical characteristics in sampled areas.

Cation Exchange Capacity (CEC)

The Cation Exchange Capacity (CEC) is the sum total of exchangeable cations that a soil can adsorb, expressed in millequivalents (me) per 100 grams of soil, clay or organic colloid. CEC is a calculated value that is an estimate of the soils ability to attract, retain, and exchange cation elements. In general, the more fertile the soil, the higher the CEC. The CEC is expressed in me / 100 g soil or cmol/kg soil, i.e. 1 me / 100 g soil is equivalent to 1 centimole of charge per kilogramme of soil (cmol/ kg soil). Soils with low retention capacity have CEC of less than 2.0 me / 100 grams of soil and the soils with CEC of more than 8 me / 100 grams soil have high retention capacity.

The CEC for all the soils sampled within the project area was between 1.85 cmol/kg soil and 7.46 cmol/kg soil. Apart from the sampling point on Solwezi – Chingola road opposite the Mulenda Dairy Farm, adjacent to access road to mine dumps, which had soils with low retention capacity (1.85 cmol/kg soil), all the soils had CEC above 2 cmol/kg soil but less than 8 cmol/kg soil. In general, the soils in the project area can be described as not have high retention capacity.

Water Holding Capacity

The water holding capacity of the soil is the amount of water obtained after subtracting the amount of water held at permanent wilting point from amount of water held at field capacity. The water holding capacity is obtained either gravimetrically gg-1, or volumetrically in cm3/cm3 or %. The results obtained volumetrically are converted to mm/m soil by multiplying the results in cm3/cm3 by 1000. Field capacity is the percentage of soil moisture that is held with water potential less than 1/3 bar and is the measure of the greatest amount of water that a soil can hold, or store, under conditions of complete wetting followed by free drainage. Field capacity values are used to determine the amount of irrigation water needed and the amount of stored

water available to plants while the permanent wilting percentage is the percentage of soil water held with water potential less than -15 bars; it is held so strongly that plants are not able to absorb it fast enough for their needs.

The soils water holding capacity (WHC) for all the soils sampled with the project area ranged from 135.5 mm/m soil to 697.4 mm/m soil. The soils sampled at Helen Dump Site had the highest water holding capacity (697.4 mm/m soil) while the soils at the right bank of the Mushishima Stream close to Helen Bridge had the lowest (135.5 mm/mol soil).

Bulk Density

Bulk density is the weight of soil for a given volume. It is used to measure compaction and to correct measurements of soil organic matter for differences in bulk density. In general, the greater the density, the less pore space for water movement, root growth and penetration, and seedling germination. Average bulk density of cultivable loam soils is 1.1 – 1.4 g cm^{-3}. For good plant growth bulk density need to be below 1.4 g cm^{-3} for clays and 1.6 g cm^{-3} for sand soils.

The bulk densities of the soils sampled ranged from 0.52 g cm^{-3} to 2.01 g cm^{-3}. The soils with a highest bulk density (2.01 g cm^{-3}) was at Helen Dump Site indicating that this soil is highly compacted for plant growth while soils at West of TD2 Dump Site (0.62 g cm^{-3}) and at the Right Bank of Mushishima River, close to Helen Bridge (0.52 g cm^{-3}) are too loose for good plant growth.

Soil Porosity

The porosity of soil is the volume of the soil occupied by air and the solution. It provides space for roots and microorganisms to breathe and for water storage.

Porosity can be measured from the volume of a nonpolar liquid such as paraffin that is absorbed into a dry bed under vacuum. Alternatively, porosity may be determined indirectly from the bulk density and particle density

For the all the soils sampled around and within the project area, soil porosity ranged from 24.15% to 80.35% with soils at right bank of the Mushishima Stream close to the Helen Bridge having the highest porosity (80.38%) and the lowest (24.15%) was recorded at Helen Dump site.

Table 6.9 below summarises the soil characteristics at sampled points.

Table 6.9: Soils Characteristic of the Project Area			
Sampling Point No.	**Description of sampling point**	**Chemical Characteristics**	**Physical Characteristics**
1	T 5 Road - Entrance to Barefoot Camp	The soils in this area are strongly acid and have low nutrient retention capacity. The levels of nitrogen are low but levels of phosphorus are adequate. To reduce acidity, these soils would require the application of agricultural lime. To enhance the nitrogen levels, the soils would require the application of nitrogen fertilizers like compound D and or urea.	This area has sandy loamy soils with a low bulk density and higher soil porosity. The water holding capacity was very high for this type of soil texture. The higher porosity could be attributed to the sand in the texture.
2	T 5 Road - Marshlands, beyond Mushishima bridge crossing	The soils are strongly acid and have low nutrient content, low levels of nitrogen and phosphorus. These soils would also require the application of agriculture lime to reduce acidity and nitrogen fertilizers.	The soils in this area have a sandy clay loam texture with a low porosity. The soils have a very high bulk density and water holding capacity. The low porosity and high water holding capacity of this soil could be attributed to the clay in the soil texture.
3	T5 Road - On other side of road, opposite sampling point No.2	The soils are strongly acid and highly leached with low levels of nitrogen and phosphorus. Similarly these soils would require the application of agricultural lime and nitrogen fertilisers.	This area has soils which are clay loam in texture. The soils had normal bulk density and porosity. The water holding capacity was very high. Similar to the above soil, the clay in the texture resulted in the soil having the normal porosity and high water holding capacity.
4	T 5 Road - Opposite Mulenda Dairy Farm, adjacent to access road to mine dumps	The area has very strongly acid soils with low nutrient retention capacity. The levels of nitrogen and phosphorus are low.	The soils in this area are sandy loam. They are of low bulk density, high porosity and very high water holding capacity.
5	West of TD 2 dump site	The site is slightly acid and has low nutrient retention capacity. The levels of nitrogen and phosphorus are low. These soils would require lime application but the dosage required will be lower than that required in the above mentioned points. Fertilizer will also be required to enhance the nitrogen and phosphorus levels.	The soils in this area have a loamy sand texture with low bulk density. The soils have a higher degree of porosity and very high water holding capacity
6	Area between TD 2 and Mushishima Stream to the north-west end (on	The soils are slightly acidic with low nutrient content and nitrogen levels. The soils are however	The area has loamy soil with a normal bulk density and porosity. The water holding capacity

Table 6.9: Soils Characteristic of the Project Area			
Sampling Point No.	**Description of sampling point**	**Chemical Characteristics**	**Physical Characteristics**
	either side of silt bund)	rich in phosphorus.	of the soils in this area was very high.
7	Area between TD 2 and Mushishima Stream to the north-west end (on either side of silt bund)	The soils were slightly acid with low nutrient retention but the levels of phosphorus slightly low.	The soils in this area have a silty loam texture with slightly high bulk density. The soils have normal porosity. The water holding capacity was very high.
8	Between PCD access road and TD2 pump station (adjacent to power line pole # 9)	The soils are of medium acidity, low nutrient retention and nitrogen but rich in phosphorus	The soils in this area are loamy sand with low bulk density, high porosity and very high water holding capacity.
9	Right of Mushishima Stream (opposite road to PCD, close to old borrow pit)	The soils in this area are slightly acidic, have low nutrient retention but rich in phosphorus.	This area has sandy loam soils with low bulk density, higher porosity and very high water holding capacity.
10	Helen Dump Site	Soils in the Helen dump site are strongly acid with low nutrient retention, nitrogen and phosphorus.	Soils in the Helen dump site have a sandy loam texture with a higher bulk density, low porosity and very high water holding capacity.
11	Right Bank of Mushishima River, close to Helen Bridge	Soils along the Mushishima bank area are strongly acid soil with low levels of nutrients, nitrogen and phosphorus.	This area has sandy loam soils with low bulk density and higher porosity. The water holding capacity of the soils in this area was slightly high.

Table 6.10: Soils Chemical Properties Analysis Results – June 2014									
Sample No.	Description of sampling point	pH ($CaCl_2$)	N (kjeldahl %)	P Bray 1 (mg/kg)	K (cmol/kg Soil)	Na (cmol/kg Soil)	Ca (cmol/kg Soil)	Mg (cmol/kg Soil)	CEC (cmol/kg Soil)
1	T 5 Road - Entrance to Barefoot Camp	4.34	0.07	7.38	0.05	0.03	1.48	0.74	2.3
2	T 5 Road - Marshlands, beyond Mushishima bridge crossing	4.36	0.06	1.89	0.04	0.06	1.79	1.05	2.95
3	T5 Road - On other side of road, opposite sampling point No.2	4.8	0.07	1.97	0.06	0.05	3.3	1.64	5.04
4	T 5 Road - Opposite Dairy Farm, adjacent to access road to mine dumps	4.43	0.03	6.65	0.05	0.02	1.06	0.73	1.85
5	West of TD 2 dump site	5.58	0.04	5.1	0.03	0.04	1.32	0.61	2.00
6	Area between TD 2 and Mushishima Stream to the north-west end (on either side of silt bund)	5.56	0.06	16.64	0.04	0.06	2.67	1.16	3.93
7	Area between TD 2 and Mushishima Stream to the north-west end (on either side of silt bund)	5.65	0.04	13.38	0.07	0.03	3.05	1.31	4.45
8	Between PCD access road and TD2 pump station (adjacent to power line pole # 9)	5.41	0.04	15.61	0.04	0.05	1.78	0.97	2.84
9	Right of Mushishima Stream (opposite road to PCD, close to old borrow pit)	5.98	0.06	22.3	0.05	0.03	5.96	1.42	7.46
10	Helen Dump Site	4.72	0.04	6.65	0.06	0.03	1.6	0.73	2.41
11	Right Bank of Mushishima River, close to Helen Bridge	4.68	0.06	6.05	0.05	0.04	0.21	1.19	1.5

Table 6.11: Soils Physical Properties Analysis Results – June 2014						
Sample No.	Description of sampling point	Bulk Density (gcm^{-3})	Water Holding Capacity (WHC) %	WHC (mm/m soil)	Texture (USDA Soil Taxonomy)	Porosity (%)
1	T 5 Road - Entrance to Barefoot Camp	1.19	27.85	278.5	Sandy Loam	55.10
2	T 5 Road - Marshlands, beyond Mushishima bridge crossing	1.64	41.20	412.0	Sandy Clay loam	38.11
3	T5 Road - On other side of road, opposite sampling point No.2	1.38	30.45	304.5	Clay loam	47.92
4	T 5 Road - Opposite Dairy Farm, adjacent to access road to mine dumps	1.12	63.49	634.9	Sandy Loam	57.74
5	West of TD 2 dump site	0.62	24.69	246.9	Loamy Sand	76.60
6	Area between TD 2 and Mushishima Stream to the north-west end (on either side of silt bund)	1.40	43.14	431.4	Loam	47.17
7	Area between TD 2 and Mushishima Stream to the north-west end (on either side of silt bund)	1.40	35.29	352.9	Silt loam	47.17
8	Between PCD access road and TD2 pump station (adjacent to power line pole # 9)	1.28	62.92	629.2	Loamy sandy	51.70
9	Right of Mushishima Stream (opposite road to PCD, close to old borrow pit)	1.12	62.52	626.4	Sandy loam	57.74
10	Helen Dump Site	2.01	69.74	697.4	Sandy loam	24.15
11	Right Bank of Mushishima River, close to Helen Bridge	0.52	13.55	135.5	Sandy loam	80.38

Land Use / Land Tenure

Proposed project site falls within the Nchanga Mine Surface Rights Area owned by KCM. Land use within the area is dominated by mining activities. The proposed new Slag Dump site was previously used as a tailings storage facility. The facility has since been substantially reclaimed. The proposed site will also be restricted for use as a slag disposal facility.

Within the broader Nchanga Mine Surface Rights Area, agricultural activities conducted by surrounding local communities have been extended into the mine surface rights area. This has particularly occurred in areas not actively used by the mine. Charcoal burning and illegal mining activities are also some of the activities being undertaken by some local communities.

Current land use activities immediately outside the mine surface rights include dairy farming, livestock rearing and other agricultural activities that include gardening and growing of groundnuts and maize. The main crop grown is maize. Fishing is done on a subsistence scale in Mushishima Stream and Kafue River.

6.8 Flora and Fauna

6.8.1 Scope and Methodology

The flora and fauna assessment was undertaken using two approaches, namely desk study and field survey. The desk study was undertaken prior to the survey and involved review of relevant literature and documents that included the following:

- The Human Health Risk Assessment Report on consumption of fish from Lubengele and Muntimpa Tailings Dams (RauEcon, 2001);
- Vegetation of Chingola District and Zambia in general (Fanshawe, 1971; Bolnick,1995);
- Zambian fishes (Utzugi and Mazingaliwa, 2002);
- International Union for Conservation of Nature (IUCN) Red List. This was reviewed to identify the conservation status of each of the observed species and to determine the impact that the project may have at species level.

Vegetation and fauna surveys were conducted as part of the field survey to determine the baseline conditions of flora and fauna. Flora aspects of the project have been characterised in terms of whether the plants are woody or non-woody while the fauna aspect has been reported according to the following groups: Mammals; Reptiles; Amphibians; Avifauna species; and Fisheries.

The details on the approaches used to determine the flora and fauna baseline conditions of the project area are presented in Appendix F.

6.8.2 Baseline Conditions

6.8.2.1 Terrestrial and aquatic flora

Miombo woodland is principally the vegetation type found in the Copperbelt region. The common tree species found in this vegetation type are *Brachystegia, Isoberliriia*, and *Julbernardia*. The natural vegetation patterns of the region have however been extensively disturbed by human activities that include mining activities, wood harvesting for fuel (charcoal production), subsistence / shifting agriculture and plantations among other activities.

The vegetation within the KCM Nchanga Mining Licence Area has equally been significantly disturbed through mining, charcoal production, subsistence agriculture and other human activities. The diversity of wildlife species within the Nchanga mining license area is poor

mainly because of mining operations, human settlements, agriculture and other human activities that have resulted in loss of wildlife habitat and subsequent loss in species diversity.

Miombo is also the dominant woodland around the project area, although the actual project area is mainly devoid of woody species as the site has been used as a tailings dump in the past. Dominant taxa around the project site area include *Brachystegia, Isoberlinia* and *Julbernada* with Marquesia macroura, Erythrophleum africanum and Parinari curatellifolia as frequent associates. The lower storey is mainly characterised by *Albizia antunesiana, Anisophyllea boehmii, Ochna* spp., *Pseudolachnostylis maprouneifolia* and *Syzygium guineense*.

Around the peripheral of the project site, a number of woody plant species occur (see Table 6.12) while actual project site is predominantly of herbaceous plants namely; *Waltera indica, Pycerus polystachyos, Digitaria nemoralis, Aerva leucura* and *Rhyachne rottboellioides*. None of these species is either threated or endangered or rare or endemic according the IUCN Red Data List. Additionally, none of these species are of special local importance.

The aquatic ecosystem has limited plant diversity. It is mainly dominated with semi-aquatic species of *Phragmites* and sedges. *Phragmites mauritianus*, commonly known as Phragmites dominates the aquatic environment of the area. A number of sedges, namely *Cyperus esculentus, C.compressus, C. Rotundus* and *C.obtusifolia* occur along the stream. All these species are common across most of the aquatic ecosystems of Southern Africa, especially along the small streams.

Table 6.12: Common woody species of the project site

Species	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Hymenocardia acida	6.481	7.692	3.319	5.831
Parinari curatellifolia	5.556	3.846	5.150	4.851
Albizia amara	12.963	7.692	5.635	8.763
Rhus longipes	7.407	11.538	3.103	7.349
Combretum collinum	15.741	11.538	7.957	11.745
Lonchocarpus capassa	10.185	11.538	6.645	9.456
Albizia versicolor	0.926	3.846	2.552	2.441
Mangifera indica	0.926	3.846	2.035	2.269
Markhamia obtusifolia	8.333	3.846	9.650	7.276
Erythrophleum africanum	2.778	3.846	7.604	4.743
Cassia singuena	6.481	3.846	6.447	5.591
Pseudolachnostylis maprouneifolia	7.407	3.846	18.008	9.754
Combretum molle	3.704	3.846	5.406	4.319
Albizia adianthifolia	2.778	3.846	3.128	3.251
Lannea stulhmannii	0.926	3.846	2.201	2.324
Steganotaenia araliacea	0.926	3.846	3.439	2.737
Toona ciliata	1.852	3.846	4.888	3.529
Baphia beaqueartii	4.620	3.846	2.833	3.766
	100.00	100.00	100.00	100.00

Ecological Services of the Project Area

Generally, the forest around the proposed project site provides a number of ecological services. Some of these services include but not limited to:

(i) Generation and maintenance of soil quality through decomposition of organic matter;

(ii) Maintenance of air quality-regulating atmosphere air composition;

(iii) Pollination and crop production e.g. bees and other insect;

(iv) Climate stabilization: Plants and other organic materials act as carbon repositories thus reducing carbon dioxide build up in the atmosphere;

(v) Prevention and mitigation of natural disasters: e.g. soil erosion, flooding through action binding actions;

(vi) Prevention and mitigation of natural disasters e.g. soil erosion and siltation of Mushishima and Chingola streams;

(vii) Provision of health care;

(viii) Income generation by local communities through sale of aquatic (eg fish) and terrestrial resources (Uapaca fruits).

6.8.2.2 Terrestrial and aquatic Fauna

In the terrestrial and aquatic fauna study, fauna has been divided into the following groups; mammals, reptiles and amphibians. A number of these animal groupings occur around the project site. However, the population of mammals is very low, with most of the mammals often cited as being of Least Concern according to IUCN Red List (Table 6.13).

Table 6.13: Mammals of the project site

Common name	Scientific name	IUCN status
Common duiker	*Sylvicapra grimmia*	Least concern
Greater Cane Rat	*Thryonomys swinderianus*	Least concern
Otter	*Aonyx capensis*	Least concern
Black-backed Jackal	*Canis mesomelas*	Least concern
Waterbuck	*Kobus ellipsiprymnus*	Least concern

The surrounding areas have been reported to have some reptiles and amphibian species. The status of these species is listed in Table 6.14. A part from *Naja massambica* and *Bitis orientans*, all the species listed below (Table 6.14), occur outside the project area. Table 6.14 also shows the status of each of these species according to the IUCN Red list.

Table6.14: Reptiles and amphibians within and around the project site		
Common name	**Scientific name**	**IUCN status**
Reptiles		
Nile monitor lizard	*Varanus niloticus*	Least concern
Crocodile	*Crocodilus niloticus*	Least concern
Cobra	*Naja massambica*	Least concern
Puff adder	*Bitis orientans*	Unknown
Amphibians		
Common frog	*Rana spp.*	Least concern
Grass frog	*Ptychadena spp.*	Unknown
Marbled Reed frog	*Hyperolius marmoratus*	Least concern

The project site has a number of avifauna. According to IUCN Red List, most of these species are of List Concern (Table 6.15). None of these species is classified as either endangered or threatened or rare.

Table 6.15: Common bird species of the project area		
Common name	**Scientific name**	**IUCN status**
Pied King fisher	*Ceryle rudis*	Least concern
African darter	*Anhinga rufa*	Least concern
Cape Turtle dove	*Streptopelia capicola*	Unknown
Spur winged goose	*Ptetctropreus gambensis*	Unknown
Long-billed crombec	*Sylvietta rufens*	Unknown
African wood owl	*Strix woodfordii*	Least concern
Flappet Lark	*Mirafra rufocinnamomea*	Least concern
African wood-owl	*Strix woodfordii*	Least concern
Flappet lark	*Mirafra rufocinnamomea*	Least concern

The project site has many invertebrates also. Table 6.16 indicates the number of order of invertebrates found within the project area.

Table 6.16: Invertebrates in the proposed site	
Common name	**Order**
Millipede	Platydesmida
Butterflies	Lepidoptera
Moths	Lepidoptera

The surrounding streams are rich in fish species. A number of these species were either observed during the survey or through consultation with the community members living in close proximity to the project site (Table 6.17).

Table 6.17: Commonly observed fish species of the project area		
Common name	**Scientific name**	**IUCN status**
Banded bream	*Tilapia sparrmanii*	Least concern
Redbreast bream	*Tilapia rendalli*	Least concern
Yellowbelly	*Serranochromis robustus*	Least concern
Blotched catfish	*Clarias stapperssi*	Unknown
Brownspot large mouth	*Serranochromis thumbergi*	Least concern
Purpleface largemouth	*Serranochromis macrocephalus*	Least concern
Thinface largemouth	*Serranochromis angusticeps*	Least concern
Sharptooth catfish	*Clarias gariepinus*	Unknown
Zigzag barb	*Barbus miolepus*	Unknown
Southern mouth brooder	*Pseudocrealabrus philander*	Unknown
Line-spotted barb	*Barbus lineomaculatus*	Least concern
Banded tilapia	*Tilapia sparmanii*	Least concern
Red barb	*Barbus fasciolatus*	Least concern
Purpleface largemouth	*Serranochromis macrocephalus*	Least concern

6.9 Archaeology and Cultural Heritage

6.9.1 Scope and Methodology

The archaeological and cultural baseline condition of the project area was determined through review of available literature data and discussions with KCM personnel.

6.9.2 Baseline Conditions

There are no known archaeological or cultural heritage sites at the proposed site. The site has been extensively used for mining operations particularly for storage of tailings from the plant area. The tailings have since been reclaimed and reprocessed at the Tailings Leach Plant (TLP).

With the broader Chingola area, there are three known archaeological sites. These are:

- Mushishima Stream Site (6.5 km northwest of the proposed slag dump site);
- Hippo Pool Site (6.5 km north of the proposed slag dump site);
- Chingola Garden Site (3.8 km north of the proposed slag dump site.

The proposed project will not affect these sites. All construction and operation activities will not be undertaken at these sites.

6.10 Traffic volume

6.10.1 Scope and Methodology

Traffic volume within the project area was determined through undertaking a traffic survey on T3 (Chingola – Chililabombwe) and T5 (Chingola – Solwezi) Roads. T3 is an international transit route servicing Chililabombwe Town and Konkola Mine including the neighbouring Democratic Republic of Congo. It is a two lane highway with asphalt concrete surfacing. T5 is the main link to the North Western Province. It services some of the country's major mines, namely: Kansanshi, Lumwana and Kalumbila. It is a two lane roadway currently under rehabilitation.

Manual counting method was used to determine traffic volume and to classify vehicles. The method involves manually counting vehicles using hand tally and manual counters/enumerators. The Chingola / Solwezi / Chililabombwe T3/T5 intersection was chosen as the location for undertaking the manual counting of traffic.

The survey was conducted from 06:00 hrs to 18:00 hrs for five consecutive days.

6.10.2 Baseline Conditions

A traffic volume through Chingola Town to Solwezi and to Chililabombwe and back from the same towns to Chingola has continued to increase over the past years. This is due to increased economic activities in Solwezi and Chililabombwe Districts and the North Western Province in general.

The average daily traffic (ADT) volumes from Solwezi to Chingola and from Chingola to Solwezi on T5 are estimated at 710 and 400 respectively while the ADT volumes from Chililabombwe to Chingola and from Chingola to Chililabombwe on T3 are estimated 1,162 and 1,175 respectively. 59% of vehicles on T5 were moving towards Chingola while 41% were moving towards Solwezi. Approximately an equal volume of traffic (50%) was moving on T3 towards Chililabombwe and back to Chingola.

The composition of the traffic volume shows that many of the vehicles were passenger cars and 5 axle semi-trailers. The data below shows a summary of traffic volume and vehicle classification for 5 days count.

Summary of Traffic Volume and Vehicle Classification for 5 Days Count																
DIRECTION	**Motorcycle and Scooter**	**Passenger Car**	**Micro Bus**	**Light Delivery Vehicle**	**Medium Delivery Vehicle**	**Mini Bus**	**Big Bus**	**Rigid Truck 2 Axles**	**Rigid Truck 3 and 4 Axles**	**Rigid Truck and Drawbar Trailer**	**Horse and Semi Trailer 3 & 4 Axles**	**Horse and Semi Trailer 5 & 6 Axles**	**Horse and Semi Trailer 7 Axles**	**Horse and Two (Semi) Trailers**	**Other vehicles**	**Average Daily Traffic (ADT)**
SOLWEZI / CHINGOLA – SOUTH DIRECTION	8	493	127	447	96	62	51	129	26	1	3	360	12	179	4	**400**
CHINGOLA / SOLWEZI – WEST DIRECTION	5	746	160	671	181	526	71	320	60	0	0	567	42	198	4	**710**
CHINGOLA / CHILILABOMBWE – NORTH DIRECTION	3	2134	602	795	135	171	45	366	172	0	0	1121	49	277	6	**1175**
CHILILABOMBWE / CHINGOLA – SOUTH DIRECTION	2	2169	633	800	163	206	43	278	130	0	0	1088	71	228	1	**1162**

Currently the dump trucks used to haul slag from Nchanga Smelter to the existing Slag Dump do not cross the T3 and the T5. With the proposed Slag Dump site, the dump trucks will be required to cross the two trunk roads (T3 and T5) during the operational phase of the dump. This will increase traffic volumes crossing the T3 and T5 roads.

The existing access roads leading to the TD2 and beyond will be used by dump trucks to haul slag from the Smelter to the proposed new Slag Dump. It is estimated that 1,500 granulated slag material will be transported every day from the Smelter to the proposed Slag Dump. This will translate into 50 dump trucks per day crossing the T3 and T5 and passing through the access roads to the proposed Slag Dump site.

The access roads will be graded and widened. Currently pedestrians and cyclists are some of the other users of access road leading to TD2 and TD3/4. The potential interaction of pedestrians and cyclists with dump trucks when the Slag Dump becomes operational poses considerable public safety risks.

6.11 Noise

6.12 Scope and Methodology

Ambient noise levels survey was conducted in May 2014 by Techfields Limited. The survey included identifying all sources of noise associated with the proposed project site at TD2 and establishing baseline noise levels at the site. It also included assessing the potential noise disturbance that could arise as a result of the proposed project.

A Sound Level Meter with instrument specification shown in Table 6.18 was used to measure noise levels at five measurement locations / points (A, B, C, D and E) identified around the proposed site. Figure 6.10 shows schematic locations of the points. The measurements

followed in-situ calibration of the Sound Meter using an acoustic calibrator and were taken on a day with calm to gentle breeze without rain. The 'A' weighted Equivalent measurement in decibels (dbA) was used as statistical tool for all measurements.

The time intervals for taking the readings were 08:00 hours to 12:00 hours; 18:00 hours to 22:00 hours and 01:00 hours to 06:00 hours.

The baseline noise levels measured were compared with Noise Levels Guidelines by the World Bank Group (WBG) to assess the potential noise impact from the proposed project.

The areas considered as sensitive noise receptors were identified during field surveys.

Table 6.18: Sound Level Meter Instrument Specification.

Manufactures	Description	Type	Serial No.
Major Tech	Sound Level Meter	MT 976	No. 07042456
Cirrus	Integrating Averaging Sound Level Meter	CR 812A	B16020FA
Cirrus	Acoustic Calibrator	CR 513	33746
	Wind Shield		

Table 6.19: Noise Level Guidelines

	One Hour LAeq (dBA)	
Receptor	**Daytime 07:00 - 22:00**	**Night time 22:00 - 07:00**
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Source: IFC General EHS Guidelines – Environmental Noise Management, 2007.

6.13 Baseline Conditions

Noise

The proposed site is bounded by T3 (Chingola – Chililabombwe Road) and T5 (Chingola – Solwezi Road). It is approximately 600 metres from T3 and about 100 metres from T3, at the closest approach. High volume of traffic characterises both roads. The topography of the area towards T5 (presence of elevated TD7 tailings dam in between T5 and the site) and the distance in between reduces noise levels from T5 received at the proposed site.

The nearest places considered as sensitive noise receptors in relation to the project site are:

- Mushishima Settlement located about 350 metres to the south of project site;
- Mushishima Primary School located about 800 metres to the south of the project site;

Other settlements (Mulenda Farm, Kamana Farm and Kalilo Village) are located over 1 km from the project site.

The Mushishima Village and Mushishima Primary School are situated a few metres (between 120 – 150 m) from the T5. These places are considered to be sensitive receptors of noise from high volume of traffic on the T5.

Table 6.20 shows the baseline noise levels as measured at the project site. The measurements show that the baseline noise levels range between 64 dBA and 39 dBA. The location (A) with the highest noise levels (60 – 64 dBA) is situated near the TD2 Pump Station while the other locations (B, C, D, E) recorded noise levels below the maximum ambient allowable noise levels recommended for residential, institutional and educational setting (see Table 6.19 and 6.20). The project area is categorised as industrial. Therefore, the baseline noise levels within the project area is within the IFC/WB Group maximum ambient allowable noise levels of 70 dBA recommended for industrial and commercial areas.

Table 6.20: Baseline Noise Survey Results

Sampling Point	08:00-12:00	18:00-22:00	01:00-06:00	Comment-Source
A	64	62	60	Machinery from pump station & traffic
B	44	39	40	Traffic, animals / community, insects / birds
C	45	40	43	Community, Insects, animals-cattle and birds
D	43	41	40	Community, Insects, animals-cattle and birds
E	51	50	47	Traffic, human

Source: Noise Assessment Report by Techfields Limited, 2014.

Vibration

Construction activity can result in ground vibrations. The degree of vibrations varies depending on the type of construction method used. Operations of construction equipment causes ground vibration which spread through the ground and reduce with distance.

Buildings in close proximity to the construction site can respond to ground vibrations with varying results. The vibrations can be perceptible in varying degrees in buildings very close to the construction site. Old fragile buildings of historical significance can easily be damaged as a result of ground vibrations caused by construction equipment.

There are no old fragile buildings of historical significance at the project site. In addition, there are no settlements in very close proximity to the project site that can be considered as vibration-sensitive areas. The nearest settlement is the Mushishima Settlement located approximately 350 m to the South of the project area at the closest approach.

There were no perceptible ground vibrations at the project site at the time of the survey.

6.14 Radiological Survey

6.14.1 Scope and Methodology

The scope of assessment for the radiological survey involved measuring gamma dose rates, and alpha and beta contamination at the following sites;

- At the proposed Slag Dump Site at reclaimed TD 2 including 100 metres periphery;

- At Mushishima Community including Mushishima School;
- Along the proposed routes for transporting the slag from the smelter to the dump site;
- Along the Chingola Stream;
- At Helen, TD 3 and Solwezi Road Bridges along Mushishima Stream;
- At the current Smelter Slag Dump within KCM Mine Plant;

The maps of the above sites are presented in Figures 6.11 to 6.21.

A Teletector 6150 AD-t with a read out 6150 AD5, Serial Number 131809, held at about 1 meter from ground level and recorded in nano Sieverts per hour (nSv/hr) was used to take gamma dose rate measurements. The instrument was calibrated on 12 July 2013 at Nuclear Energy Corporation of South Africa. The certificate of calibration is provided in the detailed Radiological Survey Report (see Appendix E).

The Automess 6150 AD6 contamination monitor with Alpha-Beta-Gamma Probe 6150 AD-17 Pancake probe was used to determine alpha and beta contamination. The instrument was calibrated on 11 July 2013 at Nuclear Energy Corporation of South Africa. The certificate of calibration is provided in the Radiological Survey Report (Appendix E). With the cap on the probe, alpha and beta are filtered giving a reading for gamma radiation only. When the filter is removed, the meter reads gross radiation comprising gamma, alpha and beta radiations. The difference between the two readings is attributed to alpha and beta radiations. These measurements were taken with the probe held at10 cm from the source and recorded in pulse per seconds (p/sec).

A detailed methodology for measurement of gamma dose rates, alpha and beta contamination, and background radiation is presented in Appendix E of this report.

6.14.2 Baseline Conditions

Gamma dose rates

The gamma dose rates for all the sites were taken and the individual results are included in the Radiological Survey Report (Appendix E). Table 6.21 below is a summary of the results.

Table 6.21a: Summaries of surface dose rates due to gamma radiation for all sites in nano sieverts per hour (nSv/hr)

S/N	Site	Surface dose rates in nano Sievert per hour (nSv/hr)	
		Average	Uncertainty
1	Proposed Site (TD 2)	181	32
2	Mushishima Community	115	14
3	Proposed Route A	140	12
4	Proposed Route B	147	16
5	Chingola Stream	145	30
6	Mushishima Stream	105	10
7	Current Slag Dump	404	54
8	Background	138	25

Table 6.21b: Summaries of surface dose rates due to Gamma Radiation for all sites in millisieverts per year (mSv/y)

S/N	Site	Surface dose rates in milli-sieverts per year (mSv/yr)
1	Proposed Site (TD 2)	1.59
2	Mushishima Community	1.01
3	Proposed Route A	1.23

Table 6.21b: Summaries of surface dose rates due to Gamma Radiation for all sites in millisieverts per year (mSv/y)		
S/N	**Site**	**Surface dose rates in milli-sieverts per year (mSv/yr)**
4	Proposed Route B	1.29
5	Chingola Stream	1.27
6	Mushishima Stream	0.92
7	Current Slag Dump	3.54
8	Background	1.21

Baseline Alpha and Beta Contamination

The alpha and beta contamination for all the sites was taken and the individual results are provided in the Radiological Survey Report (Appendix E). Table 6.22a below is a summary of the results.

Table 6.22a: Summary of Alpha and Beta Radiation Dose Rates for all sites					
S/N	**Site**	**Contamination (in Pulse per Second - PS^{-1})**			
		No cap (X)	**With cap (Y)**	**Net (X-Y)**	**Uncertainty**
1	Proposed Site (TD 2)	0.44	0.21	0.23	0.15
2	Mushishima Community	0.30	0.14	0.16	0.08
3	Proposed Route A	0.36	0.17	0.19	0.09
4	Proposed Route B	0.37	0.18	0.19	0.09
5	Chingola Stream	0.44	0.18	0.26	0.11
6	Mushishima Stream	0.36	0.13	0.23	0.06
7	Current Slag Dump	1.14	0.69	0.45	0.15
8	Background	0.37	0.24	0.13	0.14

Table 6.22b: Summary of surface contamination due to Alpha and Beta particles in Becquerel (Conversion efficiency for natural uranium is 0.4 s-1/Bq).				
S/N	Site	Contamination due to alpha and beta particles in Becquerel (Bq).		
		No cap (X)	With cap (Y)	Net (X-Y)
1	Proposed Site (TD 2)	1.10	0.53	0.58
2	Mushishima Community	0.75	0.35	0.40
3	Proposed Route A	0.14	0.43	0.08
4	Proposed Route B	0.93	0.45	0.08
5	Chingola Stream	1.10	0.45	0.65
6	Mushishima Stream	0.90	0.33	0.58
7	Current Slag Dump	2.85	1.73	1.23
8	Background	0.93	0.60	0.33

Graphical Presentation of the results for surface dose rates (mSv/yr) and contamination (Bq)

The results show that the current slag dump has the highest in both surface dose rates due to gamma radiation and activity due to alpha and beta particles. The proposed (TD2) site had the second highest surface dose rates and relatively higher in contamination due to alpha and beta particles.

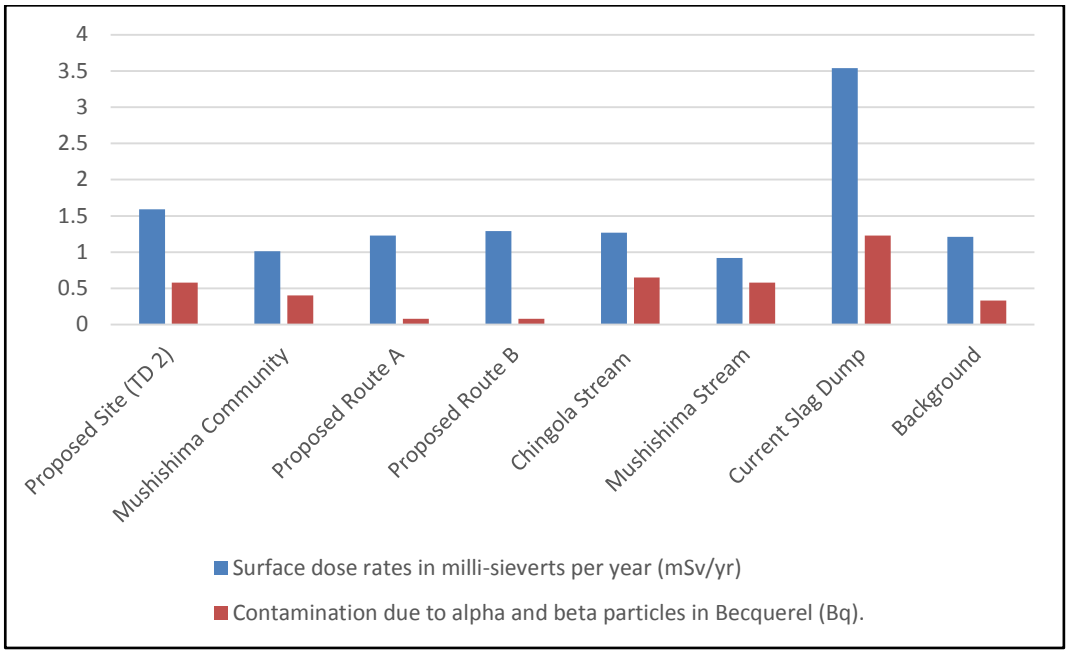


Figure 6.12: Graphical presentation of the results for surface dose rates (mSv/yr) and contamination (Bq)

Chingola Stream, proposed Routes A and B had almost the same surface dose rates but the contamination due to alpha and beta particles was high in Chingola Stream. The lowest surface dose rates were for Mushishima Stream and the lowest contamination were for the proposed Routes A and B.

6.14.3 Exposure Risks

It is assumed that the radiation levels at the proposed dump site at TD 2 will be the same as at the current slag dump. The International Commission of Radiological Protection (ICRP) recognises three categories of individuals that are at risk due to exposure from ionising

radiation as: workers, members of the public and patients. These categories of exposure are known as occupational, public and medical exposure. Occupational exposure is generally interpreted as radiation exposure of individuals as a result of their work. Medical exposure is predominantly that of patients and those caring for them. Public exposure then incorporates all exposures other than medical and occupational. The scope of the exposure risk will be limited to occupational and public.

Occupational Exposure

The Ionising Radiation Protection (General) Regulations of 2011 state that the occupational exposure of any employee shall be so controlled such that an effective dose of 20 mSv per year averaged over five consecutive years, or 50 mSv in any single year shall not be exceeded. There are two exposure risks involved with this project. The first risk is due to gamma and the second as a result of alpha and beta contamination.

Gamma Radiation Occupation Exposure

The predicted levels of gamma radiation at TD 2 are based on the levels at the current dump site. The gamma dose rate in table 4.2 is 404 nSvh-1. This converted to mSv/h is 4.04 x 10-4. It is assumed that the workers that will be handling the smelter slag will be working for 8 hours per day for 6 days a week. The total time worked (or exposure time) per year is 2, 496 hours (8hrs/day x 6 days/week x 52 weeks/year). Based on the above assumptions and calculation, Table 6.23 shows the predicted annual occupational exposure due to gamma radiation and compares it to the set limit by the Ionising Radiation Act of 2005.

Table 6.23: Annual Gamma Occupational Exposure

Dose rate at the current slag dump	Predicted Dose at TD 2 (exposure time = 2,496 hr/yr)	Ionising Radiation Act of 2005 limit per year
0.000404 mSv/hr	1.0 mSv	50 mSv

The predicted dose of 1.0 mSv is below the limit of 50 mSv per year occupational exposure set by the Ionising Radiation Act of 2005. Assuming a worker is in employment for a period of five years, the average dose per year must not exceed 20 mSv.

Alpha and Beta Radiation contamination

The smelter slag material at the current dump site has a small fraction of fine material that can be windblown and may contain some radon gas. Radon gas whose radioactive decay leads to the formation of its short lived daughters may attach to the windblown dust particles.

When inhaled with dust particles, the daughters are deposited in the respiratory tract. The radioactive half – lives of the daughters are very short, and most of them decay in the respiratory tract. Some of them emit alpha radiation which has a large biological damage to the respiratory tract tissues, including the lungs.

As for surface contamination, a reading or measurement that is more than twice the background reading or measurement is significant (Edinburgh University, Department of Health and Safety).

The contamination at the current slag dump has been used to predict the levels at the proposed site. In Table 6.24 below, the predicted surface contamination is compared to the background reading.

Table 6.24: Alpha and Beta Radiation Contamination		
Contamination in Bq at the current slag dump	Predicted contamination at TD 2 (in Bq)	Measured background contamination (in Bq)
1.23	1.23	0.33

The predicted surface contamination on the proposed site at TD 2 is 1.23 Bq compared to the background measurement of 0.33 Bq. In other words it can be stated that the predicted value is 3.7 times the background value

Public Exposure

The exposure risk of the public is also two fold, due to gamma radiation and contamination due to alpha and beta particles. The measured dose rates in Table 6.21a have been used to predict the radiation levels at TD 2 once the project takes off.

Gamma Radiation Public Exposure

In its publication, Basic Safety Standards, the International Atomic Energy Agency (IAEA), to which Zambia is a member, has set 1 mSv per year as the limit of exposure of members of the public.

Nowadays, it is not uncommon to see members of the public patronising mine waste dumps looking for copper and other minerals to sale and earn a living. In assessing the risk to exposure of the public due to gamma radiation, it is assumed that the public will have access to the proposed dump site at TD 2. Under this assumption, as they are searching for minerals, some members of the public may camp at the dump site. Others may get mine waste and stockpile it in their homes before they finally sell it. The exposure time is therefore 24 hours per day and 8, 760 hours per year (24 hours/day x 365 days/year).

The gamma dose rate at the current slag dump is mSv/h is 4.04 x 10-4. Table 6.25 below shows the exposure of the public due to gamma radiation.

Table 6.25: Annual Gamma Public Exposure		
Dose rate at the current slag dump	Predicted Dose at TD 2 (exposure time = 8, 760 hr/yr)	IAEA limit per year
0.000404 mSv/hr	3.54 mSv	1mSv

The predicted dose per year for the public is 3.54 mSv per year compared to the set limit of 1mSv per year.

Alpha and Beta Radiation contamination

The measured contamination levels at the current slag dump have been used to predict the levels of contamination at TD 2 once operations commence. Table 6.26 shows the predicted contamination. The predicted contamination has been compared to the background measurement.

Table 6.26: Alpha and Beta radiation Contamination		
Contamination in Bq at the current slag dump	**Predicted contamination at TD 2 (in Bq)**	**Measured background contamination (in Bq)**
1.23	1.23	0.33

The predicted contamination is 1.23 Bq compared to the background reading of 0.33 Bq.

The slag is generally coarse but a small fraction of fine material could be blown and cause contamination. The prevailing wind is south east and the particles being blown to Mushishima Community which is South of TD 2 is unlikely.

6.15 Socio-economic Assessment

6.15.1 Scope and Methodology

The socio-economic baseline condition of the project area was established by conducting a social baseline survey in the project area and by reviewing available literature relevant to the project. The baseline surveys were undertaken between May and June 2014.

The surveys involved identifying communities considered as key stakeholders based on their close proximity to the project area. Mushishima Community, Mulenda Dairy Farm, Kamana Farm, Munga Farm, Katungabulungu Community along the T5 Chingola-Solwezi Road, Hippo Pool Community along the T3 Chingola-Chililabombwe Road, Shimulala Community; and Kalilo Community were identified as key stakeholders during the stakeholder mapping exercise undertaken.

The fenceline stakeholders were identified as well and these include the New Mushishima Primary School, Mushishima Community, Mulenda Dairy Farm, Kamana Farm and Munga Farm.

The baseline surveys also involved holding focus group discussions and interviewing key informants. The focus group discussions were held with households in the fishing camps in order to build upon key issues, and examine more in-depth socio-economic issues and potential impacts, and help identify vulnerable receptors. The discussions covered key stakeholders from the residents downstream of the Kafue River at Hippo Pool and residents and Ward leaders at Kalilo Community.

The key informant interviews were carried out with staff at New Mushishima Primary School, DAPP Child-Aid Field Officer and Twatasha Cooperative members at Shimulala. Other key informants included the Kabungo and Kalilo Ward Councillors, farm owners of Mulenda and Kamana Farms.

	
Focus Group Discussion at Kalilo Settlement	Focus Group Discussion at Kafue Hippo Pool

Appendix L of this report presents the social impact assessment report.

6.15.2 Baseline Conditions

Demographics

National Demographic Overview

The population in Zambia presently stands at 13,092,666 having increased from 7,759,161 in the year 1990, to 9,885,591 in the year 2000 (CSO, 2010). This gives an average annual growth rate of 2.8 per cent between the period 2000 to 2010. This is an increase above the annual rate of population growth of 2.4% per annum through the inter-censal period 1990-2000.

The population is divided almost proportionately with 6,454,647 (49.3%) being male and 6,638,019 (50.7%) being females.

The majority of the population resides in the rural areas. The rural population accounts for 60.5% (7,919,216), while 39.5% (5,173,450) are urban dwellers. The population in Zambia is typically youthful, with the proportion of the population below 15 years accounting for 45.4% of the total population (CSO, 2010).

Copperbelt Regional Demographic Overview

The population of Copperbelt Province as recorded in the 2010 Census of Population and Housing was 1,972,317. Of this population 376,861 people lived in rural areas and 1,595,456 in urban areas. At District level, Kitwe District had the largest proportion of the total population with 26.2 per cent (517,543). Ndola District was next with 22.9 per cent (451,246), while Chingola District was third with a population of 216,626, representing 11.0 per cent. Lufwanyama District had the least percentage of the population in the province with 4.0 per cent (78,503). Table 6.27 below gives the demographic characteristics of the Copperbelt Province.

Table 6.27: Total Population by District, Region and Sex, Copperbelt Province, 2010					
	Total Population			Per cent of Population	
Region and District	Total	Male	Female	Male	Female
Copperbelt Province	1,972,317	981,887	990,430	49.8	50.2
Rural	376,861	190,178	186,683	50.5	49.5
Urban	1,595,456	791,709	803,747	49.6	50.4
Chililabombwe	91,833	46,792	45,041	51.0	49.0
Chingola	216,626	108,464	108,162	50.1	49.9
Kalulushi	100,381	50,164	50,217	50.0	50.0
Kitwe	517,543	256,740	260,803	49.6	50.4
Luanshya	156,059	77,368	78,691	49.6	50.4
Lufwanyama	78,503	39,182	39,321	49.9	50.1
Masaiti	103,857	52,017	51,840	50.1	49.9
Mpongwe	93,380	46,785	46,595	50.1	49.9
Mufulira	162,889	81,355	81,534	49.9	50.1

Source: Central Statistical Office, 2010

The population density for Copperbelt Province was 63.0 persons per km^2 in 2010. This density had increased from 50.5 persons per km^2 in 2000 to 63.0 persons per km^2 in 2010, representing a growth in density of 12.5 persons per km^2. Kitwe District was the most densely populated in the province with a population density of 666.1 persons per km^2. This was followed by Ndola District with 409.1 persons per km^2 and then Kalulushi District with a population density of 138.5 persons per km^2. Lufwanyama District had the lowest population density of 8.0 persons per km^2 (Central Statistical Office, 2010).

Economy

National Economic and Livelihood Profile

Zambia is categorized as a country with Low Human Development and has shown insignificant advances on the Human Development Index (HDI) value from 0.405 in 1980 to 0.448 in 2012 (United Nations Country Team, 2013). For 2012, it is ranked 163 of 187 countries (UNDP, 2013). The country is characterized by high youth unemployment, with almost 90 per cent of employed Zambians in the informal sector, with little or no job security and often underpaid and underemployed.

Zambia remains a copper driven economy and its agriculture is dominated by maize production. It, therefore, remains vulnerable to external shocks, with an unstable international economic environment being a concern for its key mineral exports (UNDP, 2013).

The Zambia 'Vision 2030' policy document outlines the country's aspirations of attaining a prosperous middle-income nation status by 2030. The Sixth National Development Plan (2011–2015) is intended to achieve the socio-economic goals, set out in the 'Vision 2030'. In particular, the plan emphasises infrastructure development, sustained positive economic growth, investment diversification within the rural sector to reduce poverty and enhanced human development (SNDP, 2010).

The mining sector remains the major source of economic growth in Zambia. This sector grew by an average of 9.8% between 2006 and 2010. Copper production has been growing between 2005-2010, and has been responsible for this growth in the sector (CSO, 2011). The sector accounts for 70.3 per cent and 8.5 per cent of country's foreign exchange earnings and formal employment respectively during the same period. Its Gross Domestic Product (GDP) increased by 20.2% from $10,705.09 million in 2006 60 $16,190.66 in 2010. In 2010 the

primary sector (agriculture and mining) accounted for 23% of total GDP; the secondary sector (manufacturing and construction) 28.6% and the tertiary sector (service industry) 46.3% of total GDP.

In human development, Zambia has not faired very well. The United Nations Development Programme (UNDP) Human Development Index (HDI) shows this. The HDI is a comparative measure of life expectancy, literacy, education and standards of living for countries in the world. The Zambia Human Development Report 2011 put Zambia's HDI value for 2010 at 0.395, positioning the country in the low human development category and ranking 150th out of 169 countries. By 2010, Zambia's HDI was still below its 1990 level. The 2013 UNDP Human Development Report records a slight change from 0.443 in 2011 to 0.448 in 2012 (Table 6.28). Currently, Zambia's HDI of 0448 is ranked 163rd out of 187 countries.

Table 6.28: Zambia's Human Development Index 1980-2012

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (PPP US$)	HDI Value
1980	51.9	7.6	3.3	1,533	0.382
1985	52.1	8.5	5.3	1,273	0.410
1990	51.1	7.9	7.5	1,226	0.423
1995	46.7	7.6	6.1	1,009	0.371
2000	42.0	7.2	5.9	1,031	0.345
2005	42.9	7.2	6.3	1,153	0.360
2010	47.3	7.2	6.5	1,359	0.395
2011	49	8.5	6.7	1,307	0.443
2012	49.4	8.5	6.7	1,358	0.448

Source: UNDP Human Development Report, 2013

The decline in human development was a consequence of structural adjustment policies of the 1990s, which increased unemployment, reduced real wages and considerably increased the prevalence of extreme poverty. This was a period of considerable reduction in public expenditures services such as health, education and social protection. Therefore, the positive economic growth of the recent past is apparently still insufficient to fully rectify the decline in the standard of living and in human development originating from what may be regarded as the "two lost decades" (ZHDR, 2011).

To put things in perspective, Zambia's 2012 HDI of 0.448 is below the average of 0.466 for countries in the low human development group and below the average of 0.475 for countries in Sub-Saharan Africa. From Sub-Saharan Africa, countries, which are close to Zambia in 2012 HDI rank and population size are Angola and Malawi, which have HDIs ranked 148 and 170 respectively (see Table 6.29).

Table 6.29: Zambia's HDI indicators for 2012 relative to selected countries and groups

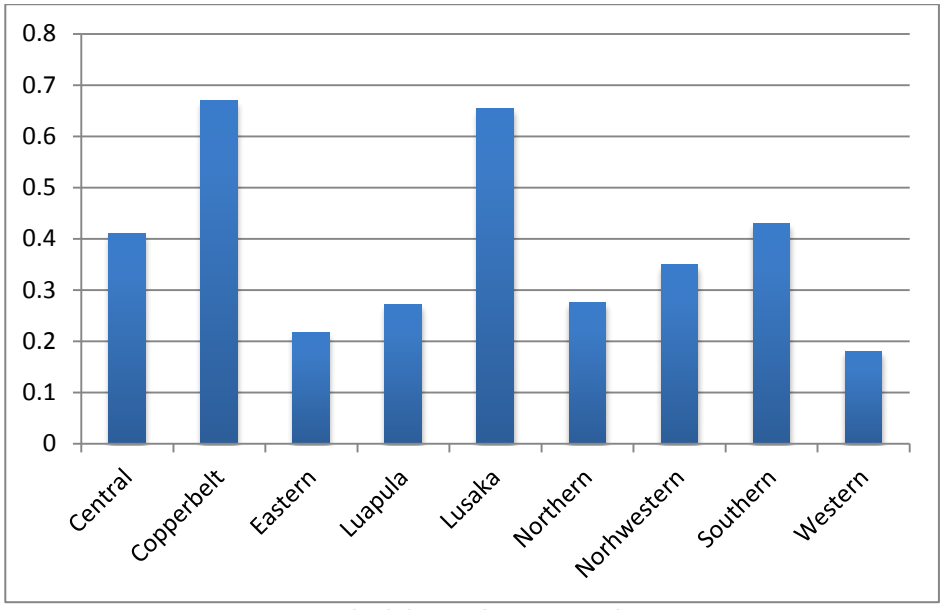
	HDI value	HDI rank	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (PPP US$)
Zambia	0.448	163	49.4	8.5	6.7	1,358
Angola	0.508	148	51.5	10.2	4.7	4,812
Malawi	0.418	170	54.8	10.4	4.2	0,774
Sub-Saharan Africa	0.475	—	54.9	9.3	4.7	2,010
Low HDI	0.466	—	59.1	8.5	4.2	1,633

The 2011 Zambia Human Development Report observes that poverty levels are still very high. This poverty that is multi-dimensional covers various deprivations at the individual level in facets of health, education and standard of living. Overall extreme poverty in Zambia was estimated at 51% in 2006. In urban areas extreme poverty declined from 32% in 1991 to 20% in 2006, while extreme poverty in rural areas stood at 67% per cent in 2006 (ZHDR, 2011). Although extreme poverty has reduced from 58 per cent in 1991 to 42.3 per cent in 2010, Zambia is still far from reaching the MDG goal of 29 per cent by 2015 (UNDP, 2013).

Regional Economic and Livelihood Profile

The main economic activities on the Copperbelt Province are mining, agriculture, trade and commerce. The province whose economy is dominated by the mining industry also has a comparative advantage in wood and wood products. Recent economic developments include the location of a Multi-Facility Economic Zone (MFEZ) that is under construction at Chambishi in Kalulushi and an Industrial Park planned to be established in Ndola (SNDP, 2010). The infrastructure in the Province is fairly well developed. An ambitious programme to rehabilitate the poor road network is currently underway.

The graph below shows the Provincial Development Index. The PDI is a composite index based on education, health and income indicators. For education the enrolment and completion rates are used to form the education index, while the life expectancy is adopted as an indicator for the quality of life of people and the household income is used as a proxy measure for the economic well-being of regions (SNDP, 2010). The Copperbelt and Lusaka Provinces have a much higher PDI. The index also provides further evidence to the high rural poverty that is widespread among the largely rural provinces.



Provincial Development Index
Source: Sixth National Development Plan (2011-2015)

Chingola District Administration

The proposed project is located in Kabungo Ward of Chingola District. The District Commissioner, who is appointed by the President of the Republic of Zambia, heads the administration. The District Commissioner's office coordinates the development functions in the district and also provides oversight over functions of Central Government and those of Local Government. All development agencies working in the district are members of the District

Development Coordinating Committee (DDCC) that is chaired by the District Commissioner. The District Council provides the secretariat.

Chingola District Council

The District Council as Local Authority is a semi-autonomous institution operating under the provisions of the Local Government Act No. 22 of 1991. It performs specific functions on behalf of Government. As the highest decision making body at the district level, the Local Authority formulates policies in the form of by-laws and regulations to guide management and development of the district. The District Council provides a forum for local representation of the public by electing their local representatives, the Councillors. A Ward Councillor represents Kabungo Ward.

Community-Based and Non-Governmental Organizations

A number of non-state actors and community-based organizations operate in Chingola District. Notable ones in the area of the proposed project include Development Aid-People to People (DAPP) a Norwegian non-governmental organization and Village Water Zambia. These organizations play a very important role in providing diverse support to communities at grass-root level.

District Population

According to the Population and Housing Census of 2010 Chingola District has a population of 216,626 people. The district has 2 constituencies, namely Chingola and Nchanga Constituencies. Chingola Constituency has 17 Wards with a total population of 123,108 people and Nchanga Constituency has 10 Wards with a total population of 86,965 people.

The proposed project is located in Kabungo Ward which has 1,447 households with a total of population 7,632 people.

Social services and amenities

Chingola District as one of the urban centres in the Copperbelt is well served by social services and amenities. Within the immediate project area, there is a primary school (Mushishima Primary School). However, there is no health centre or established market in the immediate project area close to the site.

District Level Economic and Livelihood Profile

Economic Activities

Mining dominates the local economy of Chingola District and the Copperbelt Province in general. It drives the local socio-economic activities of the district and contributes significantly to the local economy through employment and tax revenues to the local authority. KCM remains the major private sector employer in the district. Its contribution to the local economy is through the provision of direct and contractor employment offered by many firms providing goods and services to KCM.

Apart from mining, agriculture, hospitality industry, transport and general trading in various goods are other sources of livelihoods in the district.

Education and Literacy

The Government, Konkola Copper Mines Plc and the private sector provide education facilities in Chingola District. Education facilities in the district are provided through early learning centres (usually operated by private entities), Primary, Secondary and High Schools.

The district has 54 government schools, 51 private schools and 22 community schools. KCM owns and operates the Nchanga Trust School in Chingola The Trust School provides quality universal primary and secondary education to over 1000 children of both mine employees and children from the related communities. In addition, KCM provides early childhood care education and development to children/dependants of marketeers at Chiwempala Market in Chingola. The centre provides daytime meals and early learning to the children.

Other activities undertaken by KCM and that relates to education include offering of KCM Scholarship Awards to pupils at KCM and Government schools; raising of computer literacy; and development of infrastructure at schools and universities.

The nearest school to the proposed project site is Mushishima Primary School, which is located about 1 km to the South of the proposed site.

Gender Parity Index

The Gender Parity Index (GPI) demonstrates gender equity in the education system. The GPI is the ratio of female to male pupils. A GPI lower than 1 means that there are more males than females in the school system, while a GPI greater than 1 denotes the opposite. The 2013 Zambia Educational Statistical Bulletin indicates that the GPI for Grades 1-9 was 0.98 and for Grades 10-12 was 0.84. Similarly the national dropout rate of females in Grades 1-9 in 2013 was 2.1 per cent to that of 1.4 per cent for males and 1.7 per cent for Grades 10-12 females to that of 0.7 per cent for males. These national figures are also indicative of the situation at Chingola District level.

The national adult (ages 15 and older) literacy rate is 61.4 per cent (UNDP, 2014). This national literacy rate can be extrapolated at Chingola District level.

Health Facilities

Chingola District has two hospitals and several clinics operated by government and private surgeries. The Nchanga North General Hospital is operated by Government. KCM owns and operates the Nchanga South Hospital and clinics which provide quality healthcare to employees and the community. Numerous clinics and health centres are located in various parts of the district.

Within the district and like in many other districts in Zambia, malaria is one of the leading causes of morbidity and mortality. It has caused many deaths and placed a burden on the economy in terms of health care and lost productivity. Thus, as a counteractive measure, KCM initiated the roll-back malaria campaign programme which is being implemented in partnership with Government.

Water Supply and Sanitation

Mulonga Water and Sewerage Company (MWSC) provides water supply and sanitation services in urban and peri-urban areas of Chingola. MWSC is licensed by the National Water and Sanitation Council (NWASCO) to provide water and sanitation services in urban and peri-urban areas of the district. Urban residential and business premises are connected to the water supply reticulation system operated by MWSC while peri-urban settlements are supplied by communal stand pipes and water kiosks.

Road network

Chingola district is interlinked by both road and rail infrastructure. The district has a good network of urban and township roads. It is linked to other Copperbelt towns of Chambeshi, Chililabombwe, Kitwe and Mufulira by a good network of tarred trunk roads. The district is connected to north-west by the T5 Chingola-Solwezi road.

Railway

There is a freight-only railway line from Chingola to Kitwe. There is a proposed Northwest Rail which will link Chingola to Solwezi and terminate at Lumwana mine. The freight rail line is intended to haul copper ore and other mining products.

Electricity Supply

The district is connected to the Zambia Electricity Supply Corporation grid (ZESCO). ZESCO supply electricity to domestic and commercial premises. Bulk energy supply to the mines is supplied by the Copperbelt Energy Company.

Airport

The district is served by the Kasompe Airport. The airport handles both charter and passenger flights.

Telecommunication

Chingola District has good telecommunication infrastructure. Communication companies ZAMTEL, Airtel and MTN provide cellular and Internet services. These facilities are widely accessed in the district.

The government-owned Zambia National Broadcasting Corporation (ZNBC) is the principal public broadcaster. It currently runs two television channels and several radio stations. There are several private TV stations accessible in the country including the subscription Digital Satellite Television (DSTV). International broadcasters such as the BBC World Services and RFI provide some radio coverage.

Private radio stations, Christian Voice, Radio Phoenix broadcast to the district. A community radio station - Radio Ichengelo broadcasting on FM 102.2 from Kitwe, and a new radio station I-Wave broadcasting on FM 90.1 from Chingola also serves the town. The Diocese of Ndola of the Catholic Church runs the Sun FM radio station.

Religious Practices and Beliefs

Religious practices and beliefs in Zambia are central to the people. A large majority of Zambians in the district belong to the Christian faith. The district has several denominations which include the Roman Catholic Church, United Church of Zambia, Seventh Day Adventist Church, Jehovah's Witnesses, Assemblies of God Church, etc. Some also practices traditional belief systems, including the veneration of ancestral spirits. Other belief systems include Hinduism and Islam.

Gender Equity

In Zambia gender inequality is symptomatic of the overall societal orientation. This is evidenced by the fact that women generally experience disadvantages in access to education, health and employment. Access to productive assets such as land is still problematic to many women in Zambia. The Gender Inequality Index[6] (GII) a composite measure of reproductive health, empowerment and labour market participation illustrates this. In Zambia the GII is 0.617, ranking 135 out of 187 countries (UNDP, 2014).

Community Level Economic and Livelihood Profile

Agriculture

[6] The Gender Inequality Index ranges between 0 and 1, with 0 being 0% inequality.

Agriculture in the district is generally practiced at subsistence level. Many residents practice subsistence agriculture. The main crop grown is maize. Other crops include groundnuts and sweet potatoes. Maize is grown both for consumption and for market.

Mulenda Farm

Mulenda Farm owned by Mr. Gary Shiel is one of the largest farm enterprises near the project site. This is a dairy farm producing over 2000 litres of milk per day.

Kamana Farm

Kamana Farm owned by Mr. Watson Sinkala since 1981 grows rain-fed maize crop and vegetables such as cabbages. Broiler chickens are also kept.

Munga Farm

Munga Farm is located near Kamana Farm. There is very little agricultural activity at the property, except for maize cultivation.

Traditional Economic Practices

The major livelihood activities in the surrounding communities of the proposed project include fishing, agriculture and livestock rearing.

Fishing is done downstream of TD2 at a subsistence level in the Mushishima Stream and the Kafue River. Fishing hooks and nets are used to catch fish. Canoes are used on the Mushishima Stream to set the nets.

Livestock rearing in the district is practiced both at subsistence as well as commercial levels. Livestock is reared for pork, beef and dairy products. Small livestock such as goats are widely kept.

Sustainable Livelihoods Project

KCM in partnership with DAAP has been implementing the Child Aid Project. This is an integrated community development programme implemented in 10 areas in Chingola and Nampundwe. The programme focuses on income generation, personal hygiene, sustainable livelihood and training.

Through the programme KCM engaged over 120 households in the peri-urban communities of Chingola and Chililabombwe in goat rearing for food security and income generation. Families are also provided with pass on loans of small livestock and grains as well as small cash loans to engage in income generating activities in order to improve their income and subsequently better their lives. This programme has also included the communities in Mushishima, Kalilo, and Shimulala.

Water and Sanitation

On the Copperbelt KCM has funded the construction of water and sanitation facilities to improve the water and sanitation levels in schools in Chingola, Chililabombwe and Kitwe Districts. In Chingola District New Mushishima Primary School is one of the beneficiaries of this programme.

Mushishima Stream Water intake at Kamana Farm

Cabbage Patch at Kamana Farm

Water facility at Shimulala

Cattle at Shimulala Cooperative

New Mushishima Primary School

Hand Washing Facilities in Toilets at School

Non-Governmental Organizations/Community-Based Organizations

There are two non-governmental organizations operating in Chingola that have partnered with KCM to implement community development initiatives. These are Development Aid People to People (DAPP) and Village Water.

Village Water Zambia - Sustainable Livelihood Projects for Women and Small-scale Farmers

- The enhanced Sustainable Livelihood Project launched in 2012 supports 15,000 direct beneficiaries from 4,200 households and will run for five years up to 2017. The project is tailored to target 80 per cent beneficiaries from female-headed households. A joint initiative of KCM and a non-governmental organization, Village Water Zambia involves the distribution of cattle to communities in Chingola and Chililabombwe. 240 cattle and 280 goats have so far been distributed.
- Under the Sustainable Livelihood Projects KCM 46 farmers have been trained in community animal health care in Chingola, representing 23 farmers' groups out of the 27 groups project

The project was important to local communities, as the training was designed to promote best practices in community animal health, conservation and agriculture ecology farming, development of farmers and gender equity and is also seen as a way of increasing livestock production.

In particular, the project, which involves the promotion of draught cattle, is intended to change the economic status of several women in the beneficiary communities by contributing to enhance social economic transformation and improved food security in those areas.

DAPP Child-Aid Projects

DAPP has been implementing the Child-Aid project involving health promotion through hygiene campaigns and the Sustainable Livelihood Project. The livelihood initiatives include the provision of small business loans, livestock rearing, sustainable agriculture, water and sanitation, community preschool education and general community development activities. The Project networked with World Vision Zambia in identifying and linking groups and individual members to benefit from business loans. There are two beneficiary groups from Shimulala area. The project also involved entrepreneurship training involving women.

Community Profile - Mushishima

The community in Mushishima has 100 households with an approximate population of 500 people. Mushishima settlement has 150 houses and 1 church. It is located in Kabungo Ward of Chingola Constituency. According to the 2010 Census Kabungo Ward has 1,447 households with a total population of 7623 population. This settlement was formerly a school run by the Nchanga Consolidated Copper Mines in the early 1970s and was later on taken over by the Zambia Consolidated Copper Mines (ZCCM). It was later to be taken over by its subsidiary Mpelembe Drilling Company. At privatization in 1992 most of its occupants lost their jobs. Most of the former employees of Mpelembe Drilling are employed as casual or contract labour in the mines and other industries in Chingola. Currently most of the houses have been rented out to people reclaiming copper in the old dumps.

Infrastructure

The Mushishima settlement has no piped water. Potable water is obtained from water kiosks operated by Mulonga Water and Sewerage Company. The settlement has electricity provided by KCM. There are no sanitation facilities. The old communal washrooms and toilets are non-operational.

New Mushishima Primary School

There are 245 pupils at New Mushishima Primary School. Of the total number of pupils 132 are boys and 113 are girls. The school has 15 teachers. The school runs classes from Grade 1-9. It has a 1X3 classroom block. Children progressing to secondary school go to Maiteneke Secondary School, Chingola High School and the Chingola Centre for Continuing Education. All these facilities are located more than 7 km from Mushishima.

6.15.3 Build Environment

Chingola District is one of the towns on the Copperbelt Province. The local socio-economic setting of the town is largely supported by the mining operations of KCM. The town has several commercial and industrial companies that provide support services to the mining operations through general supply of goods and services, fabrication, construction and general engineering.

The extensively built-up areas are located approximately 3 km to the East and South-east of the proposed project site. The areas include KCM process plants area (concentrators, smelter, Tailings Leach Plant, etc.), other industries, commercial facilities, schools, health care facilities (hospitals, clinics), public and private offices, residential areas and other essential amenities. The residential areas include high, medium and low cost areas besides peri-urban areas. The main townships are listed in Table 6.30.

Table 6.30: Main Townships in Chingola District

Category of Township	Name(s) of Townships
High Cost	Nchanga South, Kabundi South, Kabundi East,
Medium Cost	Nchanga North, Chikola, Chingola East
Low cost	Chiwempala, Lulamba
Peri-urban	Chabanyama, Maiteneke, Kapisha, Kasompe

Water supply and sanitation services to residential, commercial and industrial areas are provided by Mulonga Water and Sewerage Company.

Farm settlements are located to the West and North of the project site. Mulenda Dairy Farm is located approximately 300 m (at the closest approach to the fence) West of the site while Kamana Farm is located across the Mushishima Stream approximately 1.2 km north-west of the project site. Hellen Compound is located about 3.5 km North of the proposed project site.

The Mushishima Settlement, located about 350 m to the south of the project site, is the nearest populated settlement with an approximate population of 500 people. The settlement has 250 houses and 1 church. A water supply kiosk constructed and operated by Mulonga Water and Sewerage Company supplies potable water to the residents at the settlement. Mushishima Primary School is located over 800 m to the south of the project site. It has a 1x3 classroom block.

Tarred roads lead out of Chingola Town to Chililabombwe, Solwezi and Kitwe towns. All the roads are tarred. The Chingola – Solwezi and Chingola – Chililabombwe roads are relatively close to the project site and are used to access the site. From the project site, it is about 400 m to the Chingola – Solwezi Road and about 100 m to the Chingola – Solwezi Road.

TD2 Pump Station is adjacent to the project site on the eastern boundary. It is about 25 m from the access road that forms the eastern boundary of the project site. The station is used to pump reclaimed tailings from Pollution Control Dam and other sources to the Tailings Leach Plant for reprocessing to recover the remaining copper.

7 Impact Identification and Evaluation

This section outlines the predicted potential impacts on the environmental and social conditions of the project area that may potentially arise as a result of the proposed Slag Dump Project. It also presents recommended mitigation measures.

The potential impacts have been identified based on the review of the project description, assessment of the project components in relation to the prevailing environmental and social baseline conditions of the project area described in Section 6. Applicable national legislations and design guidelines for the slag dump have also been used to identify and assess the potential impacts of the proposed project.

The impact assessment methodology presented in Section 5 has been used to assess and evaluate the potential impacts on the prevailing environmental and social conditions of the project site. The impacts have been characterised in terms of their nature, duration, extent, intensity, probability of impact occurring and their significance as described in Table 5.1. A summary of the predicted potential impacts is presented in Table 8.1 of this report.

7.1 Water Quality - Impact Assessment

7.1.1 Potential Impacts

Surface Water

The potential impacts on surface water relate to the following:

- Contamination of surface water caused by direct release of sediment-laden surface runoff and effluents from the Slag Dump into the aquatic environment. This can potentially result in contamination of water supply sources and disruption of aquatic life;
- Siltation of nearby rivers and streams caused by deposition of silt from the proposed project site on the streambeds. This can also result in contamination of surface water and disruption of aquatic life in nearby streams.

Surface runoff laden with suspended solids and effluents from the Slag Dump has the potential of contributing to water contamination in Mushishima and Chingola Streams. In addition, surface runoff contaminated with heavy metals from the slag material does also have the potential to contaminate receiving water courses. Direct discharge of effluents and surface runoff from the Slag Dump into the Mushishima and Chingola Streams is the potential pathway through which receiving water bodies can be contaminated and affect aquatic life. Local communities dependent on Mushishima Stream are considered as potential sensitive receptors of contaminated surface water principally through using it as potable drinking water.

The potential impacts will be negative, indirect, reversible and long-term in nature. The intensity of the impacts is assessed as high while the possibility of the impacts materialising are considered to be probable. The overall significance of the impact is assessed as medium. The slag material that will be dumped at the proposed site shows no potential to be leached with water. Therefore, surface runoff and seepage from the Slag Dump is not expected to potentially contain leached heavy metals. PCD will be the major receptor of surface runoff from the Slag Dump. Any potential contaminated surface runoff will be intercepted at the PCD and pumped back to the plant area through TD2 Pump Station. Therefore, there will not be any direct release of contaminated runoff into the nearby stream as the PCD will act as a measure to prevent any potential contaminants from reaching the sensitive receptors. Therefore, effective operations of PCD according to its design functions will play a significant role in minimising direct release of contaminated runoff and effluents into the Mushishima Stream. In

addition, the likelihood of the local communities being exposed to contaminated runoff and effluents from the Slag Dump, in the presence of an effectively functioning PCD, is low.

Groundwater

The potential impacts on groundwater resources that can arise relate to:

- Contamination of groundwater caused by flow of site runoffs and seepage from the proposed project into the groundwater regime potentially transported through fractures and faults in the bedrock.

Groundwater contamination during the construction phase is limited to potential seepage of oil spills from construction equipment into the groundwater regime. During the operation phase, groundwater contamination could potentially arise through seepage of contaminated water through the dump body into the groundwater regime. Intrusions of deep seated faults and fractured/weathered zones revealed in the competent rock units of the north-western flank of the project site are the potential pathways through which any contaminated seepage from the dump can flow into the groundwater regime. This may potentially result in groundwater contamination. This may also potentially result in surface water contamination in an event that contaminated groundwater discharges into the nearby Mushishima Stream.

The nature of the predicted impact arising from potential groundwater contamination has been assessed to be negative, indirect and reversible in nature. The impact will be localised and its intensity will be low to medium. It is probable the impact could materialise. The overall significance of the impact has been assessed has medium.

Cumulative impacts on groundwater may arise through the use of the adjacent TD7 facility as an emergency tailings storage facility, especially if acidic tailings or effluents from the main plant area are released into TD7. Acidic seepage can potentially flow into the groundwater regime resulting in the contamination of groundwater in the aquifers. The nature of the potential cumulative impact has been assessed to be negative and indirect in nature. The impact will be localised and its intensity impact will be high. It is probable the cumulative impact could materialise. The overall significance of the cumulative impact has been assessed has medium.

The design of the proposed slag dump includes installation of a filter under-drainage system to collect seepage flowing through the dumped slag material to the base of the dump. The collected seepage will be directed into the toe drain, which will direct the flow into the PCD. A Seepage Sump will be constructed as part of the drainage system at the dump and will be used as sampling point for monitoring of seepage quality.

The installation of the filter under-drainage system will minimise seepage water flowing into the groundwater regime.

7.1.2 Mitigation Measures

Surface water

The proposed mitigation measures to minimise surface water contamination will include the following:

- Implementing a water monitoring plan for the proposed project (a Monitoring Plan is included in Section 8.3 of this document);
- Routine sampling and testing of seepage and runoff from the slag dump to monitor and assess any potential contamination. Two surface water sampling points where

representative samples will be collected will be established. The parameters to be tested will be as shown in Table 8.3.

- Provision of toe drain and under-drainage filters along the periphery of the dump as per design report;
- Constructing silt traps along the periphery of the dump as per design report;
- Constructing a drainage system at the slag dump that will channel any surface runoff and seepage around the Slag Dump into the Pollution Control Dam (PCD). Any suspended solids and silt that may potentially be carried with surface runoff will be intercepted at the PCD and recycled through TLP;
- Ensuring that PCD operates effectively as per its design functions so that it also effectively functions as a major receptor of surface runoff and effluents from the proposed Slag Dump.

Groundwater

The mitigation measures to minimise potential groundwater contamination by site runoff and seepage from the Slag Dump will include the following:

- Designing the slag dump with a filter under-drainage system that will collect seepage from the dump and direct it to PCD via toe drains (detailed design has been concluded);
- Implementation of a water monitoring plan specific to the proposed project. This will include monitoring of all discharges from the slag dump (seepage and surface runoff).
- Installation of two groundwater monitoring boreholes on the north-western and south-eastern flanks of the proposed project site (as shown in Figure 6.3) to monitor and assess impact of seepage on receiving water bodies (aquifers) and taking appropriate action. Two additional boreholes will be installed as well.

The cumulative impacts should be minimised by ensuring that the operations of the Tailings Leach Plant (TLP), where acidic tailings are expected from, are optimised to reduce on potential emergency situations that can result in release of acidic tailings / solutions in TD7. TLP is also owned and operated by KCM.

7.1.3 Conclusion

The proposed project is not likely to pose significant adverse environmental impacts on surface water and groundwater resources. With the proposed mitigation measures, residual impacts are assessed to be negligible. Surface runoff and effluent from the TD2 Dump will be intercepted at PCD while seepage into the groundwater regime will be reduced by using a filter under-drainage system and will be recycled through TLP. KCM should ensure that PCD operates effectively according to its design functions. This will ensure that PCD plays a major role as the major receptor of surface runoff and effluents from the proposed Slag Dump.

7.2 Ambient Air Quality Impact Assessment

7.2.1 Potential Impacts

Dust emissions are likely to be generated during site preparation, construction, operation and closure phases.

Site preparation

The access roads leading to the proposed Slag Dump site will be graded and widened during site preparation. The existing tailings at the site will be compacted. It is expected that

earthworks of this nature will generate some dust, which can potentially be a nuisance to the local communities. The site preparation works will be carried out for a short duration and will be localised at the project site. The dust likely to be generated is expected to be low and will not be a nuisance to the local communities. The workers on site may potentially be exposed to dust emissions. The nature of the impact is predicted to be negative, short-term, direct and reversible in nature. The impact will be localised and its intensity will be low. There is a distinct possibility that the impact will occur on site but the overall significance of the predicted impact is assessed as low.

Construction Phase

During the construction phase earth and civil works to be carried out when putting up a drainage system at the site will generate some dust. The dust generated will affect the site only and will not be a nuisance to the local communities. Thus the impact will be site specific and will be low in intensity. The potential impact is predicted to be negative, short-term, direct and reversible in nature. It is probable that the impact will occur but the overall significance of the predicted impact is considered to be low.

Operation Phase

During the operation phase slag will be hauled from the plant area to the new Slag Dump for deposition. The haulage of slag will involve movement of haulage trucks on unpaved access roads daily. The trucks are expected to make approximately 50 trips per day.

The movement of trucks on unpaved access roads will release dust from the unpaved access roads. Dust generation can be considerable if the roads are very dry. Dust generation is also enhanced by the speed of haulage trucks as dust is lifted by the wheels. The dust released can have an impact in the local area and can be a nuisance to other access road users such as pedestrians and cyclists from nearby local communities. There are 109 rain days in Chingola and that will keep dust low naturally during a good number of days in the rain season. The dust also remains low so long there is moisture to bind the dust together.

The haulage trucks also emit gases and particulates from the combustion of fuel. The emissions from this source are expected to be low at the project site.

The potential impacts of dust emissions associated with haulage of slag from the plant area to the dumping site will be negative, long-term, direct and reversible in nature. The impact will cease after the operation life of the project. The impacts will be localised and its intensity will be medium. It is probable the impact could occur during the operational phase of the project but the significance of the predicted impact is considered to be low.

The slag contains some 10 – 14% moisture at the time of being loaded into haulage trucks. The slag will be dumped by end tipping from the trucks and levelled by a bulldozer. The dumping and levelling will not generate much dust as the slag is course and contains some moisture. The local winds are always present but because of the coarse nature of the slag not much dust will be generated from the slag throughout the deposition period. The potential impacts of dust emissions arising from dumping and levelling of slag have been predicted to be negative, long-term, direct and reversible in nature. The impact will cease after the operation life of the project. The impact will also be localised and its intensity will be low but the possibility of the impact materialising is considered to be very low. The significance of the predicted potential impact is therefore considered to be low.

The Slag Dump will cover a relatively large area of exposed surface of TD2 tailings storage facility, which is currently a source of fugitive dust emissions. This will result in reduction of fugitive dust emissions once the exposed surfaces of the former tailings dump are covered. The potential impacts associated with covering exposed tailings surfaces will be positive, direct,

localised and permanent in nature. The extent of the impact will be medium. It is highly probable that the predicted positive impact will occur. The significance of the impact is considered as medium.

Closure and decommissioning

The Slag Dump will remain as a permanent feature at the site after closure. It will not change much in size distribution as the slag to be dumped at the proposed site is very stable. It will maintain its physical properties. The coarser slag particles even resist rolling over as a result of wind because of the size and angular shapes which tend to lock rather than roll, as it happens with more rounded particles. The slag material has been used as part of construction material. It is possible to reclaim some of the material for use in construction. However, this optional use of slag for construction purposes has to be investigated further.

Wind-blown dust from the decommissioned dump has a potential of affecting air quality. The potential impact could be negative, indirect, long-term and reversible in nature. However, taking into account the physical properties of slag to be dumped at the proposed site, wind-blown dust from the dump is expected to be negligible. Therefore, the intensity of the predicted impact and the probability of the impact occurring are considered to be low.

7.2.2 Mitigation Measures

The mitigation measures that will be undertaken to minimise dust generation, gaseous emission and workers' exposure to dust are:

- Wetting of access road surfaces with water to suppress dust that will potentially be generated during movement of haulage trucks on unpaved access roads;
- Provision of appropriate personal protective equipment to workers that will be involved in site preparation and construction activities;
- Regular maintenance of haulage trucks and bulldozer to be used on site to ensure performance of the engines is at a high standard. This will reduce emissions of nitrogen dioxide and some particulate matter from the equipment; and
- Applying speed controls to reduce dust releases associated with high speed movement of mobile equipment. Slow moving mobile equipment will result in significant reduction in dust releases from unpaved access roads.

Dumping and levelling of slag with a moisture content of 10 – 14% will not generate significant dust. The slag is also coarse and has very low levels of silt material. Slag particle shapes also resist wind erosion as they are angular and will not roll as other more rounded particles. The slag is also expected to be stable over long periods.

Air quality monitoring is also recommended to assess if environmental issues of concern relating to dust emissions arise from the Slag Dump during closure. A detailed decommissioning and closure plan will be done towards the end of project life. During operations, should there be issues to deal with dust emissions, then progressive rehabilitation measures are to be effected.

To enhance positive impacts associated with reduction in fugitive dust emissions from relatively large exposed surfaces of TD2, a large area of TD2 footprint will be covered with slag material in line with the dump design footprint.

7.2.3 Conclusion

The assessment of air quality impacts has shown that site preparation and construction activities for the Slag Dump will release some dust but it will be of low significance and for a

short duration. It has also shown that haulage of slag over unpaved roads will generate some dust throughout the life of the operations. Dust generated during movement of haulage trucks when mitigated by keeping the haulage road surfaces wet will reduce the significance of this impact to very low.

The assessment has further shown that slag material will not be readily blown away from the dump because of its coarse nature. Hence dust emissions from the dump will be low. The coverage of 40 hectares of part of the tailings material will actually reduce fugitive dust emissions from the large exposed surfaces of the former tailings dump.

The contribution of the proposed Slag Dump to related air quality impacts will be insignificant and will not significantly increase environmental risk to the residents and communities in the area. The incremental additional impact from the project of PM_{10} and TSP will still leave the ambient air quality conditions at the project site within the Zambian Ambient Air Quality Guidelines and Limits.

With implementation of proposed mitigation measures, the residual impacts associated with dust emissions during construction and operations of the dump will be insignificant. The cumulative impacts on local air quality associated with the movement of utility vehicles between TD2 and TD3/4 will be negligible with the implementation of recommended mitigation measures. Other cumulative impacts on local air quality will be associated with wind-blown fugitive dust emissions from large exposed surfaces of reclaimed TD2 tailings storage facility.

Therefore, the contribution of the proposed project to the concentrations of particulate matter and gaseous substances in ambient air will be insignificant.

7.3 Soils and Land Use Impact Assessment

7.3.1 Potential Impacts

Soils

The potential impacts on soils mainly relate to soil erosion and soil contamination. The surface soils of the proposed site are predominantly covered with tailings material dumped on site during the operations of TD2. Substantial volumes of tailings have remained following reclamation of the tailings dump. It is understood that remains of the tailings material will form the dump base for the proposed slag dump. The footprint of the proposed slag dump will be within the reclaimed footprint of TD2. Therefore, no loss of top soils will arise as a result of the proposed project and impacts associated with loss of top soils will be negligible.

Construction activities may loosen the surface soils and tailings, making them susceptible to erosion processes by wind and rain. This can potentially result in soil erosion and discharge of sediment-laden surface run-off into the nearby Mushishima and Chingola Streams leading to reduced water quality, siltation of the streambed and loss of aquatic life. The predicted impact that may potentially arise will be negative, indirect, reversible and localised. The duration of the impact will be short-term as it will potentially occur during the construction phase. It is probable the impact will occur. The significance of the impact is however considered to be low.

Soil contamination could arise as a result of leakages of fuels and oils from construction vehicles during the construction phase and dump trucks during the operational phase. Soil contamination risks can also arise from the transportation of slags to the dump site in an event of accidental slag spills and other incidents and emergencies. Slag spills, incidents and emergencies relating to the operations of the new slag dump will therefore need to be managed.

The potential impact associated with contamination of soils is considered to be negative, indirect and localised in nature. The duration of the impact is predicted to be long-term and its intensity is high. It is probable the impact is likely to materialise. The overall significance is considered to be medium.

Land Use

The proposed project site is located within the footprint of reclaimed TD2 tailings dump. It is within the KCM Mine License Area whose land use is restricted to mining activities. Land at the project site will continue to be used for mining activities. It will particularly be used for dumping of slag.

The proposed use of the dump for disposal of slag will not affect the existing land use in the surrounding areas. Therefore, there are no significant impacts associated with the continued use of the proposed site as a dumping site for slag from the smelting process.

7.3.2 Mitigation Measures

Soils

The following mitigation measures will be implemented:

- Rainfall runoff that could potentially cause soil erosion at the project site will be controlled by constructing proper drainages and using other well-established engineering measures that slow peak runoff flow and reduce sediment loads among others.
- All construction and operations vehicles will be properly maintained to prevent any potential leakages of oils and fuel that can give rise to soil contamination.
- All the surface runoff and sediment load control features that will be constructed along the access road to the slag dump will be regularly inspected and maintained.
- In an event of an accidental slag spills outside the dump area, the slag will be cleaned up and deposited at the designated disposal area to minimise soil contamination;
- An emergency response plan specific to the proposed project will be developed and implemented to manage accidental slag spills, incidents and emergencies. The development and implementation will be done in conjunction with the existing KCM Emergency Response Plan.

Land Use

There is no significant change in land use at the project site and there are no other land uses that are likely to be affected as a result of the project. The use of the site for mining activities will continue during project implementation. Therefore, no mitigation measures are proposed.

7.3.3 Conclusion

The potential impacts anticipated from the proposed project are considered to be low. With recommended mitigation measures put in place, the significance of mitigated impacts on soils (residual impacts) will be negligible. Therefore, the proposed Slag Dump is not likely to significantly affect soils and land use within the project area.

7.4 Flora and Fauna Impact Assessment

7.4.1 Potential Impacts

Terrestrial flora and fauna

The project will involve dumping slag on the Brownfield on which some vegetation occurs. This will result in loss of vegetation within the project site. The common vegetation formation occurring on the Brownfield is mainly of herbaceous nature, the most common ones being *Waltera indica, Pycerus polystachyos, Digitaria nemoralis, Aerva leucura* and *Rhyachne rottboellioides.* These herbaceous species occur across many tailings dumps in the Copperbelt Province. According to the IUCN Red List, none of these species is either rare or endemic or threatened. As such, although the individuals of these species will be destroyed as a result of dumping of slag on the Brownfield, the resulting impacts although negative, will be site specific and permanent in nature. It is highly probable that the impact will occur but the intensity of the impact will be low. Overall significance of the predicted impact is considered to be low.

Aquatic flora and fauna

The project is unlikely to have an impact on the aquatic life because of the long distance between the water bodies and the proposed project site. However, contamination of surface and underground water may occur due to surface run-off and seepage. This may potentially arise from washing down slag into the nearby Chingola and Mushishima streams. The contamination of these water bodies can result in negative impacts on both aquatic and terrestrial life that depend on these water bodies for water.

Slag leachability tests indicate that the slag to be dumped at the proposed dump site shows no potential of being leached with water. Therefore, surface runoff and seepage water from the Slag Dump is not likely to be contaminated with heavy metals. The intensity of the potential negative impact on aquatic life will be low and the possibility of impact materialising is very low. The significance of the predicted impact arising from contaminated surfaces and seepage is low.

7.4.2 Mitigation Measures

Terrestrial flora and fauna

The loss of vegetation due to dumping of slag on the project site will be mitigated by ensuring that dumping is restricted to the inside part of the project site. No dumping of slag around the dump peripheral will be allowed. This will ensure that the existing vegetation around the peripheral is left standing.

Aquatic flora and fauna

The potential for slag to be washed down into Mushishima and Chingola Streams will be minimised by the design of the drainage system at the proposed slag dump. Surface runoff from the dump will be collected into toe drains that will join a drain leading to the Pollution Control Dam (PCD) via a sump and will be recycled through TLP via TD2 Pump Station. Any solids carried over with surface runoff will be intercepted at the sump and clear water will flow to PCD. Any solids that may potentially escape from sump will be intercepted at PCD. Therefore, the possibilities of slag being washed down into the Mushishima and Chingola Stream will be minimised by the design of the dump and the presence of PCD, which should be operated effectively according to its design functions.

Surface runoff and seepage water from the slag dump will be monitored regularly to detect any changes in its potential to be leached that may potentially affect aquatic life if discharged into nearby water bodies.

7.4.3 Conclusion

The ecological impacts of the proposed project are minimal with the identified impacts being site specific in nature and of low intensity. None of the identified species and surrounding

vegetation is of international significance. Therefore, although the ecological impacts will arise from undertaking the project, the impacts will be insignificant in nature.

The significance of residual impacts on the potential contamination of water bodies that can lead to loss of aquatic life is considered to be very low and negligible and is not likely to give rise to any material change in the environment.

7.5 Archaeology and Cultural Heritage Impact Assessment

7.5.1 Potential Impacts

The key potential impacts on archaeological and cultural heritage sites that could potentially arise during the construction phase relate to accidental damage and / or loss of archaeological and cultural heritage sites.

There are no known archaeological and cultural heritage sites at the project site. Therefore, the significance of predicted potential negative impacts of the Project on archaeological and cultural heritage sites is low.

7.5.2 Mitigation Measures

A “chance find procedure” as required under IFC Performance Standard 8 (Cultural Heritage) will be implemented during construction works. The National Heritage Conservation Commission and other relevant authorities will be informed should any discovery of archaeological and cultural heritage sites be made during the construction and operation phase of the project.

7.5.3 Conclusion

No known archaeological and cultural heritage sites have been identified at the project site. Therefore, with the implementation of recommended mitigation measures, the proposed project is not likely to cause any accidental damage to any unknown sites that may be discovered during the construction phase of the project.

7.6 Traffic Volume Impact Assessment

7.6.1 Potential Impacts

The key potential impacts associated with traffic increase crossing the T3 and T5 and the interaction of dump trucks with pedestrians and cyclists are:

- Public safety risks and traffic-related accidents potentially leading to injuries, loss of life and damage to property;
- Traffic congestion on T3 and T5 caused by dump trucks crossing the roads.

The interaction of pedestrians and cyclists with dump trucks on the access road to the proposed Slag Dump site can give rise to traffic-related accidents leading to injuries, loss of life and damage to property. The access road that the dump trucks will be using is one of the major routes to Chingola Central Business District used by the local communities settled near and beyond reclaimed TD2 tailings storage facility. Therefore, frequency of pedestrians and cyclists sharing the same access road with dump trucks is high and the likelihood of traffic-related accidents occurring such as injuries, loss of life and damage to property is equally high. The pedestrians and cyclists will be highly exposed to hazards associated with interacting with heavy mobile equipment, which include dump trucks.

The potential impacts that may arise as a result of the proposed project will be negative, long-term and regional in nature. The intensity of the impact will be very high and it is highly

probable that the impact will occur. The significance of the predicted impact is considered to be high.

The estimated frequency of 50 trucks per day hauling slag from smelter to the slag dump and crossing T3 and T5 roads has a potential to cause congestion on the roads, which can potentially lead to increased incidences of traffic-related accidents and loss of travel time. The crossing at T3 has existing traffic lights that control movement of vehicles at the junction where the access road from the plant area meets the T3. This has been in existence since the COP F&D Open Pits became operational. Therefore, the anticipated crossing of T3 by dump trucks moving between the Smelter and the proposed TD2 Slag Dump is not likely to cause significant traffic congestion and traffic-related accidents as vehicle movements will be controlled at the traffic lights.

The crossing at T5 does not have traffic lights to control movement of vehicles at the junction where the access road from the plant area meets the T5. Traffic movement is currently not adequately controlled. Dump trucks crossing the T5 to and from the Slag Dump using the proposed access road will present a significant hazard to other road users. This has the potential of causing traffic-related accidents. Taking into account that 50 trucks will be hauling slag per day (approximately 2 dump trucks per hour), the frequency of exposure to the hazard is high and the likelihood of traffic-related accidents occurring is also high.

The potential impacts associated with uncontrolled crossing of T5 road by dump trucks will be negative, long-term and localised. The intensity of the impact will be medium and it is probable the impact will occur. The significance of the predicted impact is considered to be high.

Cumulative impacts associated with increase in traffic volume as a result of economic development and opening up of new mines in North Western Province will arise. This will also potentially result in significant traffic congestion and traffic-related accidents on T3 and T5.

7.6.2 Mitigation Measures

The proposed measures to mitigate the identified impacts are:

- Segregating pedestrians and cyclists from dump trucks by putting in place systems and measures to prevent co-existing of pedestrians and the dump trucks. The local community will not be allowed to use the haulage road. An interconnecting road for use by the community will be opened up near TD2 Pump Station from the haulage road to T3 road so as to prevent the community from using the haulage road.
- Installing road safety traffic signs at T5 crossing. The signs should include “Trucks Crossing”, and “Slow Down” traffic signs.
- Lining the route with traffic-calming devices, especially near the crossing point of the dump trucks;
- Installing speed humps near the crossing point on T5 Chingola-Solwezi Road;
- Installing rumble strips on either side of T5 and T3 roads to slow down traffic toward the T3 and T5 crossing points;
- “Trucks Crossing” signs should be installed at T3;
- Improving safety communication.

7.6.3 Conclusion

The significance of the predicted impacts will be reduced with implementation of the proposed mitigation measures. Therefore, the proposed project is not likely to pose significant public safety risks and congestion if the mitigation measures proposed are effectively implemented.

7.7 Noise and Vibration Impact Assessment

7.7.1 Potential Impacts

Noise

Construction works and movement of dump trucks during the operation phase of the project have the potential to cause noise disturbance to identified noise-sensitive receptors. The residents of Mushishima Settlement and the Mushishima Primary School were identified as receptors of high sensitivity and who may be potentially affected by construction and operation noise and vibration.

Table 7.1 shows the typical noise levels for equipment that may be used during the construction and operation of the Slag Dump.

Table 7.1: Typical Noise Levels for Construction Equipment

Equipment	Levels Db at 50 feet
Dump Truck	88
Bulldozer	87
Drill Rock	98
Pneumatic Tools	85
Portable Air Compressor	81

Source: US Environmental Protection Agency, 1974.

The level of noise at the identified receptors that may potentially arise from a project site will depend on:

- Noise level from the construction equipment and dump trucks during operation;
- Estimation of operation of the equipment over a typical one hour period;
- Distance from the source to the receiver; and
- Ground attenuation (soft surface is assumed as the area between the site and identified receptors is generally vegetated with grass and a few trees).

Other factors such as meteorology will affect the noise levels received by the receptors.

Noise levels decrease as the distance from the source to the receiver increases. The rate of decrease depends upon the medium of transmission i.e. whether via “hard" or “soft”. Hard

surfaces include concrete, paving and gravel while vegetated areas and bare land form soft surfaces.

The rate of decrease for noise generated by a point /stationery source is approximately 6 decibels over hard surfaces and 9 decibels over soft surfaces for each doubling of distance.

Taking into account the baseline noise levels measured at point B (39 dBA – 44 dBA) (which is about 350 to 800 metres from sensitive receptors), the typical noise levels of construction equipment, soft ground attenuation of noise levels, it is predicted that the maximum noise levels at the nearest receptors (Mushishima Settlement, Mushishima Primary School) will not exceed the recommended maximum ambient allowable noise levels (55 dBA during day time and 45 dBA during night time) shown in Table 6.19.

Therefore, the potential noise disturbance that may arise as a result of construction and operations of the proposed Slag Dump will range from short-term to long-term and will be site specific. It is probable the impact may occur but its intensity will be low at the noise-sensitive receptors identified. The overall significance of the predicted impact will be low.

The construction workers are at risk of being exposed to high noise levels. The typical working hours will be 8 hrs. The impact associated with the exposure to high noise levels will be negative, short-term and site specific. It is highly probable the impact will occur and its intensity will be medium. The significance of the predicted impact is considered to be low.

Cumulative noise disturbance will arise from the operations of TD2 Pump Station and movement of utility vehicles around the proposed dump site but this will have negligible impact on noise-sensitive receptors (Mushishima Settlement and Mushishima Primary School).

Vibration

Blasting and impact pile drilling are construction activities that typically generate the most severe vibrations whose effects could be perceptible movement of building floors, rattling of windows, shaking of items on shelves and, in extreme cases, damage to buildings. As for the proposed TD2 Slag Dump project, construction activities will not involve activities such as blasting, pile driving, demolition and drilling or excavation in very close proximity to structures. No construction equipment that produces high levels of ground borne vibration will be used during implementation of the proposed project. Thus, no significant potential for vibration-related impacts from construction activities will arise as a result of the proposed project.

Because of the distance to the nearest vibration-sensitive receptors at Mushishima Settlement, which is located about 350 m from the project site (at the closest approach) and the anticipated construction methods, perceptible levels of ground vibration from construction equipment are not expected to occur. Therefore, Mushishima Settlement and Mushishima Primary School are not likely to be affected by ground vibrations from the proposed project.

Cumulative impacts on identified vibration-sensitive receptors may potentially occur as a result of the movement of heavy equipment on the Solwezi Road (T5) and blasting operations from nearby open pits.

7.7.2 Mitigation Measures

Best practicable means of reducing noise levels within the recommended maximum allowable limits should be used by, among other measures:

- Ensuring that all construction vehicles are well maintained and operated within their efficient performance parameters;

- Providing construction workers with personal ear protectors to protect them from risks of hearing;
- Fitting site construction vehicles and dump trucks used for haulage of slag from Smelter to dump with effective exhaust silencers and maintaining them in good efficient working order.

7.7.3 Conclusion

The significance of the potential noise impacts associated with the implementation of the proposed project is considered to be low. The residual impacts following implementation of mitigation measures is expected to be very low. Therefore, the proposed slag dump is not likely to significantly cause noise disturbance to the Mushishima Settlement and Mushishima Primary School, which have been identified as noise sensitive receptors.

7.8 Radiation Impact Assessment

7.8.1 Potential Impacts

The slag that will be dumped at the proposed Slag Dump is generally coarse but has a small fraction of fine material that could be blown and cause contamination. The fine particles contaminated with radioactive material can be lifted by wind and deposited in another area depending on wind direction. This can happen during transportation or from the dump site. It is also possible for the fine smelter slag particles to be moved by water into the surrounding streams/rivers.

Therefore, the predicted impacts on the environment are:

- Contamination of the area surrounding TD2;
- Possible contamination along the route to be adopted as the material is being moved to TD2;
- Possible pollution of the Chingola stream as the area around TD 2 drains into the same stream.

The predicted impacts will be negative and long-term in nature and the extent will be local. The intensity of the impact will be medium and it is probable the impact will occur. The significance of the predicted impact is considered to be medium without mitigation.

7.8.2 Mitigation Measures

With implementation of mitigation measures and other recommendations the significance of the predicted impacts will be reduced from medium to low. The following are the measures that KCM should implement to mitigate contamination of the environment:

- Covering the slag as it is being transported from the smelter to the slag dump to avoid surface contamination on the road from spillages as well as airborne contamination. In a case of accidental spillages, spilled slag should be removed and disposed at the slag dump;
- Planting of vegetation around the proposed slag dump site to trap any particles that may be blown by wind and contaminate the environment;
- Construct a perimeter drain leading to a point where solids could settle and be reclaimed and put back into the dump;
- Come up with a closure programme that will include covering the slag material with soil and establish vegetation on top.

It is further recommended that the follow measures / recommendations be implemented:

- Training workers that shall be working at he proposed slag dump in radiation safety;
- Developing and implementing a deliberate policy of radiation monitoring at the proposed dumping site, Chingola stream (at Chililabombwe road bridge and the confluence with Mushishima stream), and along the route to be adopted at selected points at least once a month;
- Constructing wheel baths for the dump trucks, one at the Acid Plant Gate and the second at the exit of the proposed site at TD2;
- Posting signage around the Slag Dump perimeter to warn the public of radiation and unauthorised access;
- Creating public awareness on the dangers of being exposed to radioactive substances;
- Fencing off the dump site and providing tight security to stop possible public accessibility;
- Covering the Slag Dump surface with 30cm of soil and establish vegetation cover at closure of the dump.

These recommendations are not only based on three fundamental principles of justification, optimisation and dose limitation upon which the ICRP System of Radiation Protection is based but also on the Zambian regulations governing ionising radiation.

The principle of justification requires that any decision that alters the radiation exposure situation should do more good than harm; in other words the introduction of a radiation source (in this case the proposed Slag Dump site) should result in sufficient individual or societal benefit to offset the detriment it causes.

The principal of optimisation requires that in the likelihood of incurring exposures, the number of people and the magnitude of their exposure should all be kept as low as reasonably achievable, taking into account economic and societal factors.

The third principle of the ICRP's system of protection is that of dose limitation. This principle requires that the dose to individuals from planned exposure situations other than medical exposure of patients should not exceed the appropriate limits recommended by the Commission.

7.8.3 Conclusion

The significance of impacts on the environment for this project is predicted to be low provided the proposed mitigation measures are followed through. These measures and recommendations should be included in financing the project. It is possible for residual impacts to occur and a contingency should be allowed for such. It is therefore proposed that the mitigation and recommendations be factored in a re-worked project proposal.

7.9 Social Impact Assessment

7.9.1 Potential Impacts

Definition of Impact Zone or Areas of Influence

The area of influence for the proposed project is both localized and regional. The local area of influence relates to the TD2 project footprint on the immediate surroundings, and also extends many kilometres downstream of the Mushishima Stream and Kafue River.

The direct area of influence of the proposed project covers all areas directly affected by project impacts on sensitive social receptors. The direct area of influence is divided into:

(i) Fence line social receptors (such as settlements located in close proximity of the project – less than 3 km) or 'on the fence-line' of the project footprint. This includes the New Mushishima Primary School, Mushishima Community, Mulenda Dairy Farm, Kamana Farm and Munga Farm.

(ii) Non-Fence line social receptors located in the direct area of influence but not in close proximity of the project. This includes the settlements of Katungabulungu, Kalilo, Fisonge, Shimulala, Kakosa and Kafue Hippo Pool downstream along the Kafue River from the project site.

Noise and vibration

The noise-sensitive receptors in the surrounding areas of the project site include Mulenda Dairy Farm, Kamana Farm, Mushishima settlement, New Mushishima Primary School, which are all located less than 3km from the project site. The closest noise sensitive receptors are Mushishima Settlement and the New Mushishima Primary School. The settlement is about 350 m from the closest approach to the project site while the school is about 1 km from the same point. There are 100 households in Mushishima settlement while the school has 245 pupils attending class.

Noise disturbance and vibrations from heavy plant machinery such as dump trucks are the potential impacts that could affect the identified social receptors. This could potentially occur during the construction and operation phase of the project. The duration of the impact would range from short-term to long-term and its extent would be local. The intensity of the impact is considered to be medium.

A noise assessment done as part of the baseline study (see Noise Assessment Section 6) indicates baseline noise levels for the proposed dump site, which can be categorized as an industrial/ commercial mining area. The levels fall within the acceptable guidelines by the International Finance Corporation (IFC), which is 55dB for social receptors such as residential areas and schools.

The noise decay is given by the following formula: *Decay = 20 log (distance/10) dB*[7]

Barrier attenuation will be provided by the sides of the old part of TD2 just next to T5 Solwezi Road. Taking into account barrier attenuation and distance between the source of noise and the noise-sensitive receptors, it is predicted that the maximum noise levels at the nearest receptors (Mushishima Settlement and Mushishima Primary School) will not exceed the recommended maximum ambient allowable noise level of 55dB for social receptors.

Secondary Impact Zone (Wider Area of Influence)

The Secondary Impact Zone includes the district-wide social receptors with socio-economic and infrastructure impacts engendered by the project. These include both residents and non-residents of Chingola who travel along the T5 Chingola-Solwezi Road.

Traffic / safety

The proposed project will contribute to increase in traffic across existing T3 and T5 roads. The road users will be subjected to traffic delays as dump trucks crisscross the Chingola-Solwezi Road with their payload destined for dumping at TD 2.

[7] Decay = 20 log (400/10) dB for Dump Truck with noise levels measured at 10 metres. It is nearly 400 metres to the nearest social noise receptor at Mushishima Settlement. Noise decay = 32.04 dBs Values given for Dump Trucks is 88 dBs.

There are also potential road safety risks and road traffic accidents along the proposed access route arising from potential interaction of pedestrians, cyclists and dump trucks that will be hauling slag from smelter to TD2 Slag Dump. The proposed route for dump trucks is one of the major routes used by pedestrians and cyclists from villages situated across the Mushishima Stream and beyond traveling to Chingola.

Traffic movement along the T5 (Chingola – Solwezi Road) and the dump trucks crisscrossing the T5 do also have the potential to cause traffic accidents.

The potential traffic-related risks and impacts associated with this setting are accidents leading to personal injuries, loss of life and damage to property. These potential impacts will be negative, short-term to long-term term and regional in nature. The intensity of the impact will be very high and it is most likely the impact will occur. The overall significance of the impact is considered to be high.

A section of the proposed Dump Truck Route

Vegetable Market at Junction of Truck Route

Road along TD 2 used by cyclist and pedestrians

Heavy Truck on the T5 Solwezi Road

Dust emission

The pedestrians and cyclists using the access road that run parallel to the proposed slag dump site and other dumps in the area will be exposed to dust emissions arising from the movement of dump trucks. Under extreme conditions, particularly in dry season, significant dust generation can lead to loss of visibility and can be a safety concern. Dust emissions will negatively impact on the local air quality that can affect pedestrians and cyclists. Dust emissions may also affect nearest receptors such as the Mushishima Settlement. The potential impacts on sensitive receptors associated with dust emissions will be negative and localised in

nature. The duration of the impact will be long-term. The intensity of the impact on sensitive receptors will be very high and it is most likely the impact will occur. The overall significance of the predicted impact is considered to be high.

Water Pollution

The local community members of Mushishima, Shimulala and Hippo Pool settlements expressed concern on potential water pollution of the Mushishima stream that may arise as a result of the proposed project. This is a concern as many of the local communities depend on the stream for water supply for irrigation of gardens and other uses. Water pollution may arise if contaminated surface runoff and seepage water from the slag dump is directly discharged into the receiving waters. The potential for any possible surface water contamination has been assessed in Section 6. The potential impacts on the local communities that may arise as a result of surface water contamination could be negative, indirect, reversible and long-term in nature. The intensity of the potential impact is considered to be very high and it is probable the impact can materialise. The overall significance of the predicted impact is considered to be medium to high.

The slag material that will be dumped at the proposed site shows no potential to be leached with water. Therefore, surface runoff from the slag is not expected to contain leached heavy metals. Any surface runoff and seepage from the dump will be intercepted at PCD, and recycled back to TLP via TD2 Pump Station.

Security anxieties

The dumping of slag at the proposed site is likely result in an influx of illegal miners interested in reclaiming copper from the slag. The illegal miners will pose security threat especially to the fenceline stakeholders (Mushishima Settlement) communities in close proximity to the project area. The presence of illegal miners in the immediate project area could result in increased theft cases and other crime incidences in the community of Mushishima.

Loss of Land and Settlement

The proposed project will not induce any loss of land, customary rights and settlements for the surrounding communities, as the project is located on mine land. In addition, the project will not induce any loss of amenity assets, loss of ethnicity, loss of access to common resources (water front, forest, etc.) and damage to agricultural or related assets.

The existing access route that runs parallel to the proposed dump site and other mine dumps in the area and currently being used by local communities to get to town will be used by the dump trucks. Therefore, use of the existing access road by the local communities is likely to be lost or restricted. The potential impact will be negative, direct, local and long-term. Its intensity will be medium. It is probable the impact will occur. The significance of the impact is considered as medium.

Resettlement and Vulnerability

The proposed project is being implemented on a brown-field site. There will be no need for resettlement of the surrounding population in Mushishima settlement, which is located far from the operation site area. There are no fields that will be affected by the operations. Therefore, there is no compensation issue associated with the proposed project.

The key potential negative impacts are summarised below:

- Noise on noise-sensitive receptors arising from operations of construction equipment and movement of dump trucks ;
- Dust emissions caused by the movement of dump trucks along unsealed access road;

- Traffic-related risks and accidents caused by interaction of pedestrians, cyclists and dump trucks hauling slag from the smelter to the proposed dump site, increase in traffic crisscrossing the T3 and T5 roads;
- Surface water pollution in the Mushishima Stream;
- Security concerns from potential influx of illegal miners into Mushishima Community;
- Restricted use of the existing access roads.

The proposed slag dump is critical to the operations of the Nchanga smelter. Assuming the proposed project is not implemented, the smelter could be shut and this could lead to job losses and redundancies. The positive impacts of implementing the project, therefore, include:

- Securing of direct and indirect employment opportunities for KCM Smelter employees and contractors;
- Safeguarding of livelihoods of employees and other contractors at smelter dependent on income from smelter for their livelihood;
- Continued promotion of local economy through supply of goods and services to smelter as it continues to be operational;
- Sustained revenue to government through taxes.

7.9.2 Mitigation Measures

The following are the proposed mitigation measures for identified significant impacts:

Noise disturbance

- Ensuring that all construction vehicles are well maintained and operated within their efficient performance parameters;
- Fitting site construction vehicles and dump trucks used for haulage of slag from smelter to dump with effective exhaust silencers and maintaining them in good efficient working order.

Dust emission

- Water Bowsers will be used spray water and / or molasses to supress dust generated during movement of haulage trucks on access roads.
- Applying speed controls to reduce dust releases associated with high speed movement of mobile equipment. Speed will be limited to 40 km/hr. Slow moving mobile equipment will result in significant reduction in dust releases from unpaved access roads.

Traffic related risks and accidents

Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of road users, including those who are most vulnerable to road traffic accidents such as cyclists and pedestrians.

The recommended measures include:

- Adopting limits for trip duration;
- Minimizing pedestrian interaction with operational vehicles by ensuring that traffic routes for dump truck and pedestrians are adequately segregated. Collaborating with local communities and responsible authorities to improve signage, visibility and overall safety of roads;

- Embarking on community awareness aimed at educating and sensitising the local communities and other road users on traffic and pedestrian safety and the need to adhere to traffic rules and regulations;
- Lining the route should with traffic-calming devices, especially near the crossing point of the dump trucks;
- Installing traffic lights at the crossing point on T5 Chingola-Solwezi Road.
- Improving safety communication – the local community may be at risk from a potential traffic hazards arising at the dump trucks movements. The communication measures to alert the community should include:
    - Communicating details of the nature of the traffic hazard;
    - Communicating safety options;
    - Providing advice on selecting any appropriate route that minimises interaction with heavy equipment;
    - Collaborating with local communities on education about traffic and pedestrian safety;
    - Involving the Road Transport and Safety Agency in sensitising the local communities, especially Mushishima Settlement and pupils at the New Mushishima Primary School.

Water Pollution in Mushishima Stream

- Routine sampling and testing of seepage and runoff from the slag dump to monitor and assess any potential contamination that may contribute surface water pollution.
- Provision of toe drains and under-drainage filters along the periphery of the dump to collect surface runoff and seepage as per design report;
- Constructing silt traps along the periphery of the dump as per design report;
- Constructing a drainage system at the slag dump that will channel any surface runoff and seepage from the slag dump into the Pollution Control Dam (PCD). Any suspended solids and silt that may potentially be carried with surface runoff will be intercepted at the PCD.

Security

- Extending and tightening 24 hours security patrols within the project area.

7.9.3 Conclusion

The significance of the predicted impacts has generally been assessed as high. The proposed mitigation measures will reduce the significance of the impacts. The residual impacts will be low. These should be addressed by sensitising the local communities and other road users on road safety and to use designated routes, which must be constructed to avoid interaction of the heavy equipment / dump trucks with pedestrians and other road users.

With implementation of the proposed mitigation measures, the proposed project is not likely to have significant impacts on the social receptors.

List of People Consulted during the Socio-economic Baseline Survey

1. Ms. Lomanzti Mazyopa Kachingwe KCM Community Liaison Officer CSR Department
2. Mr. Brian Siatubi KCM Community Liaison Officer CSR Department
3. Mr. Moses Munkondya KCM Environment Coordinator – Corporate
4. Mr. Jim Mwape Kabungo Ward Councillor
5. Mrs. Bina Mhango Kalilo Ward Councillor
6. Reverend Mary M Tembo Head teacher New Mushishima Primary School
7. Reverend Jonathan Lengwe Chingola
8. Mr. Matthews Bwalya Child-Aid Project Leader Mushishima
9. Mr. Gary Shiel – Mulenda Farm
10. Mr. Watson G Sinkala – Kamana Farm
11. Mr. Rogers Kamina – Twatasha Cooperative, Shimulala
12. Mr. Diamond Sikanyika - Twatasha Cooperative, Shimulala
13. Mr. Peter Shiku - Twatasha Cooperative, Shimulala
14. Mr. Davies S. Kanshimba – Kalilo Ward Vice-Chairperson
15. Mr. Lovewell Ng'ambi Kalilo Resident
16. Mr. J Lampeni Chingola Municipal Council Community Development Assistant Kalilo
17. Mr. Benson Lusenga Information Publicity Secretary Chingola Constituency, Kalilo
18. Mr. Happy Simundi, Ward Development Committee Member, Kalilo
19. Mr. John Chifwaha, Kalilo Resident
20. Mr. Rogers Kakompe Kalilo Resident
21. Mr. Duebison Mpumba Kalilo Resident
22. Mr. Kafwila Lambakasa Kalilo Ward Chairperson
23. Mr. Peter Chama Kalilo Resident
24. Mr. Rodwell Gondwe Kalilo Resident
25. Mr. Japhet Machila, Katungabulungu Resident
26. Mr. L Bwalya Kafue Hippo Chairman
27. Mr. B Mulenga Kafue Hippo Chairman Secretary
28. Mr. Davies Kabwe Kafue Hippo Chairman Vice-Chairman
29. Mr. P Chansa Kafue Hippo Resident
30. Mr. B Mwansa Kafue Hippo Resident
31. Mr. M. Mwila Kafue Hippo Resident
32. Mr. K. Kenani Kafue Hippo Resident
33. Mr. F. Ngoma Kafue Hippo Resident
34. Mr. M Mumbi Kafue Hippo Resident
35. Ms. C Mable Kafue Hippo Resident
36. Ms. H Chansa Kafue Hippo Resident
37. Ms. M Malise Kafue Hippo Resident
38. Ms. J Lombe Kafue Hippo Resident
39. Ms. K Mutula Kafue Hippo Resident
40. Ms. Chikopela Kafue Hippo Resident
41. Mr. F. Komba Lumba Kafue Hippo Resident
42. Ms. B Benni Kafue Hippo Resident
43. Ms. M Costan Kafue Hippo Resident
44. Mr. L Joe Kafue Hippo Resident
45. Mr. Nyirongo Kafue Hippo Resident
46. Mr. D. Musonda Kafue Hippo Resident

7.10 Effectiveness of mitigation measures

Mitigation is an integral part of environmental assessment. It is aimed at the avoidance and reduction of project-related impacts. Therefore, effectiveness of mitigation measures plays a critical role in ensuring that significant impacts are sustainably managed through environmental management.

For the proposed TD2 Slag Dump Project, mitigation measures for identified potential impacts have been recommended. The mitigation measures have been considered in a hierarchy consisting of avoidance / prevention, minimisation, compensation / offset and enhancement measures in that order of preference. The hierarchy is based on the principal that it is preferable to prevent the generation of impacts than to counteract their impacts. Therefore, mitigation measures higher in the hierarchy (avoidance) should be considered in preference to the ones below (enhancement). Where it is not possible to avoid significant negative impacts, measures to reduce the impacts or limit the exposure of receptors to impacts should be implemented. Compensation measures should be sought if it is not possible to significantly reduce the impacts to low levels. The option of enhancement measures is placed at the lower level in the hierarchy.

Based on the mitigation hierarchy, avoidance measures represent the cheapest and most effective forms of mitigating the impacts. It offers the greatest benefit of avoiding impacts early in the project planning cycle. It includes measures that take into account siting, design, process, technology, route alternatives and “no go” options to avoid impacts. Minimisation measures aim at reducing the impact or to limit the exposure of receptors to impacts. The measures are aimed at limiting the severity of the impacts and not avoiding them completely. Compensation measures aim at achieving no net loss. They represent on-site or off-site measures considered early in the project planning process.

In addition, enhancement measures represent measures aimed at achieving net positive gain. They are applied in parallel with other compensation measures to encourage opportunities to limit the scope and scale of impacts and on improving environmental features. Enhancement measures may result in a win-win situation and improve prospects for project acceptability.

In evaluating the effectiveness of the proposed mitigation measures for the proposed TD2 Slag Dump Project, the measures were identified under each item in the hierarchy, i.e. avoidance measures, minimisation measures, compensation measures and enhancement measures. A total of 50 different measures have been recommended to mitigate the identified potential impacts that may arise from implementation of the proposed project. 80% of the measures are aimed at reducing the impact or limiting the exposure of receptors to identified potential impacts while 12% of the measures are aimed at avoiding the impact. Measures to compensate and to enhance represents 4% each of the total mitigation measures recommended (see Table 7.2).

It should be noted that for mitigation measures to be effective, they must be implemented and a provision for monitoring their effectiveness should be put in place. Therefore, implementing 80% of the measures will reduce the potential impacts and limit expose of receptors to same impacts. Implementation of all the measures will be monitored to assess the success of mitigation and to adjust them where appropriate.

Table 7.2: Types of measures to mitigate identified potential impacts	
Type of mitigation measures	**Mitigation measures (% of Total)**
Avoidance / Prevention	12
Minimisation	80
Compensation / Off-set	4
Enhancement	4

8 Environmental Management and Monitoring Plan

This section presents an Environmental and Social Management and Monitoring Plan for the proposed new slag dump at TD2. It highlights the roles and responsibilities for implementation of the plans as well as the monitoring and auditing requirements.

8.1 Environmental Management Plan

KCM Nchanga Mine has an Environmental and Social Management Plan (ESMP) that covers environmental and social management issues and impacts associated with its operations at Nchanga Mine. The ESMP consolidates measures to mitigate significant environmental and social impacts, and provides a framework for implementing and monitoring the effectiveness of management actions that KCM has committed itself to undertake. It has been developed to meet the requirements of Zambian environmental legislations and objectives set in KCM Sustainability Policies and to conform to IFC requirements on Environmental and Social Sustainability of projects.

The proposed slag dump will also be constructed and operated in accordance with the applicable Zambian legislations and existing KCM Sustainability policies and procedures.

An environmental and social management plan for the construction and operation of the slag dump has been developed based on identified potential environmental and social impacts predicted to occur during project implementation and on proposed mitigation measures. The impacts and mitigation measures have been consolidated into an impact management Plan specific for the proposed Slag Dump.

The plan is based on the impacts identified in Sections 7 and summarised in Table 8.1. It is also based on relevant mitigation requirements. The plan is incorporated in this section of the ESIS and is presented in Table 8.2.

The Environmental Department at KCM Nchanga Integrated Business Unit will be responsible for implementation of management actions to manage the environmental and social aspects pertinent to the project during the construction and operations of the slag dump. The department will work closely with personnel in charge of the operations of the Smelter Complex and other relevant departments

The aspects that need to be managed have been defined in line with the identified environmental and social impacts. This has been done in order to avoid or minimise potential adverse environmental and social impacts, and to enhance beneficial impacts arising from the construction and operations of the new smelter.

The plan will be reviewed and updated regularly to accommodate changes in environmental management practices. It will be incorporated as required in the overall KCM ESMP, which is revised and updated in accordance with the national environmental regulations and relevant IFC/World Bank Guidelines.

The ESMP for the proposed slag dump is laid out in Table 8.2 with headings as outlined below:

Environmental Aspect: these are elements of the activities or products regarding construction and operation of the slag dump that interact with the environment.

Potential impact: predicted impact that may arise as a result of the proposed project.

Objectives: the targeted objectives to address the environment and social issues by mitigating specific potential impacts.

Mitigation Measures (management actions): the management commitments made to meet the objectives.

Frequency of Monitoring: the rate or time of checking that mitigation measures recommended are implemented.

Time frame: the duration within which the measure will be undertaken.

Performance Indicators: pointers to indicate that the measure has been successfully implemented.

Responsible person: indicates the person or group of people (or department) who will be responsible for ensuring the implementation of management action/commitment.

Cost: Estimated cost of undertaking the mitigation measure.

Cost Source: source of funds for implementation of the measure or task.

This ESMP will be implemented at an estimated project cost of over USD 950,000.

8.2 Roles and Responsibilities

Management actions required to mitigate identified environmental and social impacts have been included in the ESMP. The overall responsibility for Safety Health and Environment (SHE) of the organisation falls under the Chief Executive Office. The SHE Manager – Smelting and Refining, who reports to the General Manager – Smelting and Refining, will be directly responsible for management of all environmental aspects / issues related to the project. The Manager will be assisted by the Environmental Coordinator - Nchanga Smelter. The SHE Manager – Smelting and Refining will also work in collaboration with Manager – Environment who is at corporate level and is assisted by the Environmental Coordinator – Projects.

The Environmental Coordinator will be responsible for coordination and monitoring of activities relating to the implementation of the project. He will work closely with the Smelter project team and the contractor who will be engaged to construct the dump. All safety issues relating to the project will be a responsibility of Manager – Safety and Implementation who is at corporate level. The Head – Safety Nchanga Smelter will be directly responsible for safety issues relating to the slag dump project. He will be assisted by Safety Officers. Figures 8.1 and 8.2 show, respectively, the corporate sustainability organisation – management and the sustainability organisation for SHE Operations – Smelting and Refining.

Other departments such as Corporate Social Responsibility (CSR) will also play significant roles in implementing specific commitments in the Plan.

8.3 Environmental and Social Monitoring Plan

KCM Nchanga Mine has been implementing an Environmental Monitoring Plan at Nchanga Mine. The plan is aimed at monitoring environmental performance, ensuring compliance with statutory environmental regulations and meeting KCM Sustainability policies.

The issues pertaining to environmental and social monitoring of project activities are highlighted in Tables 8.2 and 8.3. The existing surface and ground water monitoring protocols will be extended to the proposed project, where applicable. This will include monitoring of seepage water and surface runoff from the dump.

Surface water will be monitored weekly while groundwater will be monitored monthly. The frequency of monitoring should be reviewed as required and in compliance with regulatory requirements.

Dust fall and radiation monitoring will also be monitored. The frequency of monitoring and the indicative parameters to be monitored are included in Table 8.3. The parameters can be reviewed as and when required.

Quality Control and Quality Assurance should be incorporated in environmental monitoring. The monitoring and sampling procedures should conform to both Zambian and internationally recognized standards and procedures. For non-compliant environmental monitoring results, appropriate corrective action should be taken to prevent future non-compliance.

Other equally important issues that will need to be monitored will include but not limited to the following:

- Dumping of slag to ensure that it conforms to approved design and does not extend outside the designated area;
- Inspection of the dump regularly (monthly for routine inspections and two-yearly for statutory inspections) to ensure construction is to design specifications with appropriate drainage system, dumping rules are being followed, etc.;
- Annually surveying the dump to ensure that it is stable.
- Rehabilitation of the dump in line possible alternative future use after decommissioning and closure. This could involve covering the slag dump surface with suitable capping material (soils) and planting trees and grasses on covered surfaces.

The social monitoring protocols will be extended to the proposed project. They will be updated based on the socio-economic issues pertaining to the proposed project.

8.4 Environmental Auditing and Reporting

Environmental auditing and inspections of the operations of the proposed slag dump will be undertaken to assess compliance to commitments made in the Environmental and Social Management Plans for the project. In addition, environmental auditing will be conducted to ensure that environmental monitoring activities being undertaken at the site are accurate and relevant to meeting the environmental management objectives set in the plan.

The environmental auditing and inspections will serve the purpose of measuring environmental performance, promoting continual improvement in the environmental management of the operations and activities at the slag dump. It will also demonstrate compliance with national legislation, regulations and the conditions that will be contained in various environmental licenses and permits that KCM will hold for operation the slag dump.

Both internal and external audits will be conducted periodically as required. Internal environmental audits on the construction and operation of the proposed dump will be conducted by KCM. External environmental audits and inspections will be carried out by independent firms or relevant government bodies who include Zambia Environmental Management Agency, Mine Safety Department among others.

Statutory environmental audits are conducted annually as required under the regulations relating to the Environmental Protection Fund provided for under the Mines and Minerals (Environmental) Regulations, 1997. Under the same regulations, statutory inspection of mine dumps is also provided for. The proposed slag dump will be subjected to these audits and inspections and statutory reports are submitted to relevant statutory bodies mandated to monitor operations of mine dumps.

8.5 Incidents and Accidents Action Pan

An incident and accident action plan has been formulated based on the identified hazards. It is presented in Table 8.4 of this report. The plan includes management actions to prevent incidents or accidents that could result in injuries, loss of life and damage to property. The plan will be reviewed to take into account changing circumstances. The periodic reviews of the plan will ensure that precautions put in place to control the risks are effective.

Scope

The plan will cover the proposed slag dump project. It will be integrated with the existing Emergency Procedure implemented by KCM at Nchanga Mine Site.

Responsibility

It will be the responsibility of the Safety Manager to ensure that the plan is implemented and periodically reviewed. This will serve to ensure that the risks associated with the haulage of slag from smelter to the proposed dump site are effectively controlled. The Safety Manager will work in collaboration with other relevant managers. In the case of a major incident involving spillage of slag, the Safety Manager will work in collaboration with the Manager - Environment Manager and others, who will spearhead implementation of mitigation measures aimed at cleaning the site.

The dump truck operators have the legal responsibility to comply with the provisions of the Road Traffic Act, 2002 enforced by the Road Transport and Safety. In addition, all dump truck operators will be required to comply with the KCM SHE Policy and to adhere to Vedanta Technical Standard on Transportation and Logistics Management (VED/CORP/SUST/TS 18).

Hazard Identification

Potential incidents and accidents will be identified by undertaking a risk assessment. The assessment will be used to identify the hazards that may result in harm during the construction and operation of the slag dump. The identification of hazards will be undertaken by asking construction equipment and dump truck operators with extensive experience on hauling of material in dump trucks across and along roads with high volume of traffic, both vehicular and pedestrian traffic.

A number of factors will be taken into account during the identification of hazards and these will include but not limited to construction equipment and dump truck operators, pedestrians, vehicles and the road.

Preliminary identification of the hazards indicates that the hazards listed below have the potential of resulting in injuries, loss of life and damage to property.

- Incompetent operators incapable of driving in a way that is safe for them and other road users;
- Improperly trained operators;
- Operators not sufficiently fit and health to operate dump trucks or construction equipment;
- Construction equipment and dump trucks not being suitable (fit) for the purpose for which they are used;
- Construction equipment and dump trucks not being maintained in a safe and fit condition;
- Safety equipment not properly fitted and maintained;

- Poor road signage at the road crossings on T3 (Chingola-Chililabombwe Road) and T5 (Chingola-Solwezi Road) and along the access roads to the dump.

The risks associated with the identified hazards are high. The hazards have the potential of causing harm to operators, pedestrians, cyclists and other road users.

The road safety infrastructure (road signage, speed humps, etc.) will be installed at appropriate points to prevent the potential incidents and accidents that may potentially be associated with the hazards. Additional measures will be recommended and implemented based on the detailed assessment of the road crossings on T3 and T5 when the slag dump becomes operational.

The assessment will be monitored and reviewed to ensure that the risks to the operators and other road users are suitably controlled. A system of gathering, recording and analysing information about the incidents in relation to the construction and operation of the new slag dump will be put in place.

A detailed action plan for incidents and accidents will be prepared following construction and operation of the slag dump.

8.6 Cost for Implementing EMPs

The total project cost for the eight segments of the slag dump stands at approximately USD 10 million. The first segment cost is USD 950,000. The overall cost for implementing environmental management and monitoring plan for the 20 years dumping life is pegged at 20% of the overall cost. This works out to be USD 2 Million.

However, wherever possible estimated cost have been proposed for certain management and monitoring plans as indicated in Table 8. 2.

8.7 Study Limitation

Available environmental and social baseline data has been presented in this report. This was gathered from primary and secondary sources. The air quality baseline sampling for $PM_{2.5}$, PM_{10} and TSP were derived from sampling periods which are less than 24hr periods. The results of 30minute sampling are given as being indicative in the area.

The emissions from the Slag Dump and haulage roads are derived from empirical studies which are not the exact replica of conditions like at this site. None the less, they can be used by incorporating some local modifications.

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
1	Dumping of slag at the proposed site.	Surface water	Contamination of surface water in nearby rivers and streams caused by runoff from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
2	Dumping of slag at the proposed site.	Surface water	Siltation of nearby rivers and streams caused by silt from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
3	Dumping of slag at the proposed site.	Surface water	Contamination of surface water in nearby rivers and streams caused by runoff from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
4	Dumping of slag at the proposed site.	Surface water	Siltation of nearby rivers and streams caused by silt from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
5	Dumping of slag at the proposed site.	Surface water	Contamination of surface water in nearby rivers and streams caused by runoff from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
6	Dumping of slag at the proposed site.	Surface water	Siltation of nearby rivers and streams caused by silt from the proposed project site	operation	negative; indirect; reversible	long-term	local	high	probable	Medium
7	Dumping of slag material at the proposed dump	Groundwater	Contamination of groundwater caused by site runoff and seepage from the proposed project site	operation	negative; indirect; reversible	long-term	local	medium	probable	Medium
8	Dumping of slag material at the proposed dump	Groundwater	Contamination of groundwater caused by site runoff and seepage from the proposed project site	operation	negative; indirect; reversible	long-term	local	medium	probable	Medium

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
9	Grading of access roads	Air Quality	Exposure of surrounding community and workers on site to dust emission generated during grading of access road.	Construction	negative; direct; reversible	Short-term	Local	Medium	Probable	Low
10	Levelling and compacting of the dump site	Air Quality	Exposure of workers on site to dust emission generated during levelling and compacting of site.	Construction	negative; direct; reversible	Short-term	Local	Medium	Probable	Low
11	Haulage of slag from smelter to the proposed dump site.	Air Quality	Releases of dust from the roads may affect surrounding communities	Operation	negative; direct; reversible	Long-term	Local	Medium	Probable	medium
12	Windblown dust from the final slag dump after closure	Air Quality	Windblown dust may affect surrounding communities	Decommissioning and closure	negative; direct; reversible	Long-term	Local	Medium	Improbable	Low
13	Dumbing of slag at TD2	Air Quality	Reduction in fugitive dust emissions from TD2 arising from covering with slag exposed surfaces on the tailings dump.	Operations / Closure	Positive; direct; irreversible	Permanent	Local	Medium	Highly probable	Medium
14	Construction of the slag dump and associated infrastructure.	Soils and Land Use	Soil erosion caused by construction activities	Construction	negative; indirect; reversible	Short-term	Local	Low	Probable	Low
15	Construction of the slag dump and associated infrastructure.	Soils and Land Use	Soil erosion caused by construction activities	Construction	negative; indirect; reversible	Short-term	Local	Low	Probable	Low

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
16	Construction of the slag dump and haulage of slag from smelter to the proposed dump site.	Soils and Land Use	Soil contamination arising from leakages of fuel and oils.	Construction and operations	negative; indirect; reversible	Long-Term	Local	Low	Probable	Low
17	Haulage of slag from smelter to the proposed dump site.	Soils and Land Use	Soil contamination arising from spillage of slag.	Operations	negative; indirect; reversible	Long-Term	Local	high	Probable	medium
18	Haulage of slag from smelter to the proposed dump site.	Soils and Land Use	Soil contamination arising from spillage of slag during transportation from the smelter to the new slag dump.	Operations	negative; indirect; reversible	Long-Term	Local	Low	Probable	Low
19	Dumping of slag at the proposed dump site	Terrestrial flora and fauna	Loss of terrestrial flora and fauna at the project site	Operations	Negative; direct; reversible	Short term	Site specific	low	highly probable	Low
20	Dumping of slag at the proposed dump site	Aquatic flora and fauna	Loss of aquatic flora and fauna due discharge of contaminated runoff and seepage into nearby water bodies.	Operations	negative; indirect; reversible	medium	Local	low	Probable	Low
21	Dumping of slag at the proposed dump site	Aquatic flora and fauna	Loss of fauna due discharge of contaminated runoff and seepage into nearby water bodies.	Operations	Negative; indirect; reversible	medium	Local	low	Probable	Low
22	Excavation works associated with the construction of the slag dump	Archaeological and cultural heritage	Accidental damage and / or loss of archaeological and cultural sites	Construction	Negative; direct; irreversible	permanent	National	medium	Improbable	Low

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
23	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance	Noise disturbance to nearest noise-sensitive receptors	Construction	negative; indirect; reversible	short-term	Site specific	low	Probable	Low
24	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance	Noise disturbance to nearest noise-sensitive receptors	Construction	negative; indirect; reversible	short-term	Site specific	low	Probable	Low
25	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance	Noise disturbance to nearest noise-sensitive receptors - workers	Operation	negative; indirect; reversible	long-term	local	medium	Probable	medium
26	Construction of the proposed slag dump	Socio-economic	Noise disturbance and vibrations from heavy plant machinery such as dump trucks	Construction and operations	negative; indirect; reversible	long-term	Site specific	low	Probable	Low
27	Construction of the proposed slag dump	Socio-economic	Road safety risks and road traffic accidents along the proposed access route arising from potential interaction of pedestrians, cyclists and the dump trucks.	Construction and operations	negative; indirect; reversible	long-term	Regional	very high	highly probable	high
28	Construction and operation of the proposed slag dump	Socio-economic	Exposure of pedestrians and cyclists using the access road to the proposed slag dump site to dust emissions arising from the movement of dump trucks.	Construction and operations	negative; indirect; reversible	long-term	Local	very high	highly probable	high

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
29	Operation of the proposed slag dump	Socio-economic	Pollution of water supply source (Mushishima stream) that may arise as a result of the proposed project	Operations	negative; indirect; reversible	long-term	Regional	very high	probable	medium
30	Operation of the proposed slag dump	Socio-economic	Security concerns arising from potential influx of illegal miners into Mushishima Community.	Operations	negative; indirect; reversible	long-term	Local	very high	highly probable	high
31	Operation of the proposed slag dump	Socio-economic	Local communities (pedestrians / cyclists) restricted to use existing access road.	Operations	Negative; direct; reversible	Long-term	Local	Medium	probable	Medium
32	Operation of the proposed slag dump	Socio-economic	Securing of direct and indirect employment opportunities for KCM Smelter employees and contractors;	Operations	positive; direct; reversible	long-term	Regional	very high	Definite	high
33	Operation of the proposed slag dump	Socio-economic	Safeguarding of livelihoods of employees and other contractors at smelter dependent on income from smelter for their livelihood;	Operations	positive; direct; reversible	long-term	Regional	very high	Definite	high
34	Operation of the proposed slag dump	Socio-economic	Continued promotion of local economy through supply of goods and services to smelter as it continues to be operational.	Operations	positive; direct; reversible	long-term	Regional	very high	Definite	high
35	Operation of the proposed slag dump	Socio-economic	Sustained revenue to government through taxes	Operations	positive; direct; reversible	long-term	National	high	highly probable	high
36	Dumping of slag material at the proposed dump	Radiation	Contamination of the area surrounding TD2;	Operations	negative; direct; reversible	long-term	local	medium	probable	medium
37	Haulage of slag from smelter to the proposed dump site.	Radiation	Possible contamination along the route to be adopted as the material is being moved to TD2;	Operations	negative; direct; reversible	long-term	local	medium	probable	medium

Table 8.1: TD2 Slag Dump Project – Summary of Environmental and Social Impacts										
No.	Environmental Aspect/Issue	Affected Environment	Potential Impact	Timing of Impact	Nature of predicted impact (N)	Duration of the Impact (D)	Extent of the impact (E)	Intensity of the Impact (I)	Probability of the Impact (P)	Significance of predicted impact (S) = (D+E+I)xP
38	Release of seepage and effluents from the dump	Radiation	Possible pollution of the Chingola stream as the area around TD 2 drains into the same stream.	Operations	negative; direct; reversible	long-term	local	medium	probable	medium
39	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Traffic	Public safety risks and traffic-related accidents leading to injuries, loss of life and damage to property on the part of other road users.	Operations	negative; indirect;	long-term	local	very high	high probable	high
40	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Traffic	Traffic congestion on T3 and T5 roads.	Operations	negative; direct	long-term	local	medium	probable	Low

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
1	Dumping of slag at the proposed site.	Contamination of surface water in nearby rivers and streams caused by release runoff and seepage water from the proposed project site	To minimise contamination of surface water.	Provision of toe drain and under-drainage filters along the periphery of the dump;	one-off activity done during construction	Construction	Toe drains and under-drainage filters constructed.	Smelter Manager / SHE Manager	400,000	Project cost
2	Dumping of slag at the proposed site.	Contamination of surface water in nearby rivers and streams caused by release of runoff and seepage water from the proposed project site into nearby streams.	To minimise contamination of surface water.	A drainage channel will be constructed to direct runoff and seepage from the sumps to Pollution Control Dam.	On-going	Operation phase	All surface runoff released into PCD	Smelter Manager / SHE Manager	30,000	Project cost
3	Dumping of slag at the proposed site.	Siltation of nearby rivers and streams caused by release of silt from the proposed project site into nearby streams	To minimise siltation of nearby rivers and streams.	Constructing silt traps (effluent sump) along the periphery of the dump.	one-off activity done during construction	Construction	Presence of constructed silt traps on the periphery of the dump.	Smelter Manager / SHE Manager	-	Covered under 1
4	Dumping of slag at the proposed site.	Siltation of nearby rivers and streams caused by release of silt from the proposed project site into nearby streams.	To minimise siltation of nearby streams and rivers.	Regular desilting of the Pollution Control Dam will be continued.	-	Operation phase	Compliance with effluent quality standards	Smelter Manager / SHE Manager	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
5	Dumping of slag material at the proposed dump	Contamination of groundwater caused by seepage from the proposed project site	To minimise contamination of groundwater.	The slag dump will be constructed with filter under-drainage system.	-	Construction	Functioning under-filter drainage system.	Smelter Manager / SHE Manager	-	Covered under aspect no1
6	Dumping of slag material at the proposed dump	Contamination of groundwater caused by site runoff and seepage from the proposed project site	To minimise contamination of groundwater.	Installation of four new groundwater monitoring boreholes - two on the western and northern flanks, and two on eastern and southern flanks, of the proposed project site	-	Prior to commencement of dumping	Four groundwater monitoring boreholes installed.	Smelter Manager	25,000	Project cost
7	Grading of access roads to the new slag dump.	Exposure of surrounding community and workers on site to dust emissions generated during grading of access road.	To reduce dust from haulage roads	(i) Bowser will be used to spray water and/or molasses to suppress dust. (ii) Haulage tracks will not exceed 40km/h speed limit.	Daily	Project life	No dust clouds when trucks are moving. Record of speed checks.	Smelter Manager	50,000-	Project cost
8	Levelling and compacting of the dump site	Exposure of workers on site to dust emission generated during site preparation (levelling and compacting of site).	To minimise exposure of workers to dust emission.	Provision of adequate and appropriate personal protective equipment to workers that will	Daily	Continuously	All workers in approved attire.	Head - Safety / Site Supervisor	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
				be involved in site preparation and construction activities.						
9	Construction of the drainage system and haulage of slag to the new dump site.	Air pollution caused by releases of gaseous emissions and particulates from haulage trucks.	To reduce gaseous and particulate emissions.	Regular maintenance of haulage trucks and bulldozer to be used on site to ensure performance of the engines is at a high standard.	Weekly	Continuously	No visible black smoke and dirt exhaust from vehicle	Transport Fleet Engineer	-	contractual agreement
10	Haulage of slag from smelter to the proposed dump site.	Releases of dust from the roads may affect surrounding communities	To reduce dust from haulage roads / access roads.	(i) Bowser will be used to spray water and/or molasses to suppress dust. (ii) Haulage tracks will not exceed 40km/h speed limit.	Daily	Continuously	All workers in approved personal protective equipment.	Site Supervisor	-	Operations budget
11	Dumping of slag on TD2	Releases of gaseous emissions may affect workers on site	To reduce emissions from haulage trucks and bulldozer	Regular maintenance of equipment	Weekly	Continuously	Record of maintenance of equipment	Maintenance Engineer	-	contractual agreement
12	Windblown dust from slag dump	Windblown may affect surrounding community	To minimise levels of dust in ambient air.	Fast growing tree species such as eucalyptus will be planted	weekly	Annually	green belt	Environmental Officers	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
				around the project site						
13	Dumping of slag at TD2	Reduction in fugitive dust emissions from TD2 arising from covering with slag exposed surfaces on the tailings dump.	To enhance reduction of fugitive dust emissions from TD2.	Covering large area of TD2 footprint with slag material in line with the dump design footprint.	As and when dumping is done	Operations	Fugitive dust emissions from TD2 reduced.	Smelter Manager	-	Operations budget
14	Construction of the slag dump and associated infrastructure.	Soil erosion caused by construction activities and runoff	To minimise soil erosion	Maintenance of silt traps (effluent sump), periphery drains and the Pollution Control Dam cavity	-	continuously	Presence of appropriate drainage system	Smelter Manager	-	Operations budget
15	Construction of the slag dump and associated infrastructure.	Soil erosion caused by construction activities	To minimise soil erosion	Surface runoff and sediment load control features to be constructed along the access road to the slag dump will be regularly inspected and maintained.	Seasonally	Operations	Maintenance and inspection reports	Smelter Manager	-	Operations budget
16	Construction of the slag dump and haulage of slag from smelter to the proposed dump site.	Soil contamination arising from leakages of fuel and oils.	To minimise soil contamination	All construction and operations vehicles will be properly maintained to prevent any potential	Weekly	Operations	No incident of soil contamination. Vehicle maintenance record.	Smelter Manager	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
				leakages of oils and fuel.						
17	Haulage of slag from smelter to the proposed dump site.	Soil contamination arising from spillage of slag.	To minimise soil contamination	In the event of an accidental slag spill outside the dump area, the slag will be cleaned up and deposited at the designated disposal area;	As required	Operations	No incidence of accidental slag spillages.	Smelter Manager	-	Operations budget
18	Haulage of slag from smelter to the proposed dump site.	Soil contamination arising from spillage of slag during transportation from the smelter to the new slag dump.	To minimise soil contamination	An emergency response plan for the proposed project will be developed and implemented in conjunction with the existing KCM emergency response plan	-	Project life	Emergency response plan developed and implemented.	Smelter Manager	-	Operations budget
19	Dumping of slag at the proposed dump site	Loss of terrestrial flora and fauna at the project site	To minimise loss of terrestrial flora and fauna	Restricting dumping of slag to the inside part of the project site to avoid destroying vegetation on the peripheral of the project site.	Daily as and when dumping continues.	On going	Peripheral vegetation left standing	Environmental Coordinator	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
20	Dumping of slag at the proposed dump site	Loss of aquatic flora and fauna due discharge of contaminated runoff and seepage into nearby water bodies.	To minimise loss of aquatic flora and fauna.	A drainage channel will be constructed to direct runoff and seepage from the sumps to Pollution Control Dam, where it will be recycled back to TLP via TD2 Pump Station.	-	Construction	Drainage system constructed	Smelter Manager	-	Operations budget
21	Excavation works associated with the construction of the slag dump	Accidental damage and / or loss of archaeological and cultural sites	To minimise noise disturbance	A "chance find procedure" as required under IFC PS (Cultural Heritage) will be implemented during construction works. The National Heritage Conservation Commission and other relevant authorities will be informed should any discovery of archaeological and cultural heritage sites	As required	Construction	Minimal negative impacts to sites of archaeological and cultural significance.	Site Supervisor / Environmental Coordinator	-	Covered under aspect no 1

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
				be made during project implementation.						
22	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance to nearest noise-sensitive receptors	To minimise noise disturbance	All construction and operation vehicles will be well maintained and operated within their efficient performance parameters and will be fitted with effective exhaust silencers.	Weekly	Construction and operations	Zero complaints recorded on noise	Smelter Manager / Environmental Coordinator	-	Operations budget
23	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance to nearest noise-sensitive receptors	To minimise noise disturbance	Construction during site preparation will be scheduled during the daytime.	As required	Construction and operations	Construction schedule and adherence thereof.	Smelter Manager	-	contractual agreement
24	Construction works and movement of dump trucks hauling slag to the dump site.	Noise disturbance to nearest noise-sensitive receptors - workers	To minimise noise disturbance	Providing construction workers with personal ear protectors to protect them from risks of hearing;	Daily	Construction and operations	Workers in approved personal ear protectors.	Head - Safety / Site Supervisor	-	Operations budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
25	Construction of the proposed slag dump	Public safety risks and road traffic accidents along the proposed access route arising from potential interaction of pedestrians, cyclists and the dump trucks.	To minimise traffic-related accidents arising from the interaction of pedestrians, cyclists and the dump trucks.	Segregating pedestrians and cyclists from dump trucks by putting in place systems and measures to prevent co-existing of pedestrians and the dump trucks. The local community will not be allowed to use the haulage road.	Daily	Project life	Zero harm	Smelter Manager / Head - Safety	-	Operations budget and project budget.
26	Construction of the proposed slag dump	Public safety risks and road traffic accidents along the proposed access route arising from potential interaction of pedestrians, cyclists and the dump trucks.	To minimise traffic-related accidents arising from the interaction of pedestrians, cyclists and the dump trucks.	Road safety signage and speed limiters will be installed	Daily	Project life	Safety risks reduced significantly during the construction and operation of the dump.	Smelter Manager / Head - Safety	10,000	Project cost.
27	Construction of the proposed slag dump	Public safety risks and road traffic accidents along the proposed access route arising from potential interaction of pedestrians, cyclists and the dump trucks.	To minimise traffic-related accidents arising from the interaction of pedestrians, cyclists and the dump trucks.	Lining the route with traffic-calming devices, especially near the crossing point of the dump trucks; Installing speed	Daily	Project life	Safety risks reduced significantly during the construction and operation of the dump.	Smelter Manager / Head - Safety	-	Covered under aspect no 26

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
				humps near the crossing point on T5 Chingola-Solwezi Road; Improving safety communication.						
28	Construction and operation of the proposed slag dump	Exposure of pedestrians and cyclists to dust emissions arising from the movement of dump trucks.	To minimise exposure of pedestrians and cyclists to dust emissions.	Bowser will be used to spray water and/or molasses to suppress dust.	Daily	Construction and operations	No dust clouds recorded	Site Supervisor / Environmental Coordinator	-	Covered under aspect no 7
29	Construction and operation of the proposed slag dump	Exposure of pedestrians and cyclists to dust emissions arising from the movement of dump trucks.	To minimise exposure of pedestrians and cyclists to dust emissions.	Speed will be limited to 40km/h on the haulage road.	As required	Construction and operations	Reduced dust emissions on the access road. Record of speed controls.	Environmental Coordinator / Head - Safety	-	contractual agreement
30	Operation of the proposed slag dump	Pollution of water supply source (Mushishima stream) that may arise as a result of the proposed project	To prevent pollution of water supply sources	Toe drains and under-drainage filters along the periphery of the dump will be constructed to collect surface runoff and seepage as per design report;	-	Construction	Presence of appropriate drainage system	Smelter Manager / Site Supervisor	-	Covered under aspect no 1
31	Operation of the proposed slag dump	Pollution of water supply source (Mushishima stream) that may arise as a result of	To prevent pollution of water supply sources	Silt traps will be constructed along the periphery of the dump as per	-	Construction	Presence of appropriate drainage system	Smelter Manager / Site Supervisor	-	Covered under aspect no 1

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
		the proposed project		design report.						
32	Operation of the proposed slag dump	Pollution of water supply source (Mushishima stream) that may arise as a result of the proposed project	To prevent pollution of water supply sources	A recycle pumping system to be installed for pumping effluent from the dump back to Tailings Leach Plant.	-	Construction	Zero discharge from the dump to Mushishima Stream	Smelter Manager / Site Supervisor	500,000	Project cost
33	Operation of the proposed slag dump	Pollution of water supply source (Mushishima stream) that may arise as a result of the proposed project	To prevent pollution of water supply sources	A channel drain will be constructed to reroute effluent and surface run-off from TD2 footprint into the PCD.	-	Construction	Presence of appropriate drainage system	Smelter Manager / Site Supervisor	-	covered under aspect no 32
34	Operation of the proposed slag dump	Security concerns (increased incidences of theft cases and other crime incidences) arising from trespassers such illegal miners	To minimise security risks and concerns	Security patrols within the project area will be undertaken.	Daily	Operation	Number of security personnel on site	Smelter Manager	-	As above
35	Operations of proposed slag dump	Restriction of local communities (pedestrians / cyclists) to use existing access road to be used by dump trucks.	To offset impacts associated with restricting use of existing access road by local communities.	An interconnecting road will be opened up near TD2 pump station from the haulage road to T3 so as to	One-off activity	Prior to operations	Detour from TD2 to T3	Smelter Manager	15,000	Project cost

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	Environmental Aspect/Issue	Potential Impact	Objectives	Mitigation Measures	Frequency of monitoring	Timeframe	Performance Indicators	Responsible Person	Cost (USD)	Cost Source
				prevent the community from using the haulage road.						
36	Operation of the proposed slag dump	Securing of direct and indirect employment opportunities for KCM Smelter employees contractors and suppliers; safeguarding livelihoods of employees and contractors; continued promotion of local economy through supply of goods and services to the smelter.	To enhance beneficial impacts associated with the project.	Allocating adequate resources for continued operations of the smelter and the proposed slag dump.	On-going	Project life	Continued operations of smelter and slag dump. No employment opportunities lost.	General Manager - Smelter	-	Operations budget
37	Operation of the proposed slag dump	Sustained revenue to government through taxes	To enhance beneficial impacts associated with the project.	Allocating adequate resources for continued operations of the smelter and the proposed slag dump.	On-going	Project life	Continued operations of smelter and slag dump. No employment opportunities lost.	General Manager - Smelter	-	Operations budget
38	Dumping of slag material at the proposed slag dump site.	Possible pollution of the Chingola stream as the area around TD2 drains into the same stream	To minimise pollution of nearby streams (Chingola)	Construct a perimeter drain leading to a point where solids could	one-off activity	Construction	Presences of a constructed perimeter drain.	Smelter Manager	-	Covered under project costs.

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
			with radiation.	settle and be reclaimed and put back into the dump						
39	Dumping of slag material at the proposed slag dump site.	Possible pollution of the Chingola stream as the area around TD 2 drains into the same stream	To minimise pollution of nearby streams (Chingola) with slag particles.	Effluent recycling facility will be installed at the New Slag dump.	Radiation monitoring done once per month.	Radiation monitoring put in place prior to commencement of dumping	Zero discharge	SHE - Manager / Environmental Coordinator	720,000	Covered under KCM environmental monitoring budget
40	Haulage of slag from smelter to the proposed dump site.	Contamination of the area surrounding TD 2 and the route through which the slag will be transported.	To minimise surface contamination on the roads and area surrounding TD2 with radiation.	Overloading of slag during transportation will not be allowed. Spillage of slag during transportation will be avoided, and where incident happens, will be immediately cleaned up. Offenders will be subjected to disciplinary. Slag will be transported whilst the moisture contain is still high.	Continuously	Operations	No spillages observed.	Smelter Manager / Head - Safety	-	Covered under KCM smelter / slag dump operations.
41	Dumping of	Contamination of	To minimise	Planting of	Seasonally	Operations	Standing	SHE - Manager	-	Operations

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
	slag material at the proposed slag dump site.	the area surrounding TD 2	contamination of the area around TD2 arising from wind-blow slag particles that may escape from the dump and contaminate the environment.	vegetation around the proposed slag dump site as wind breaker.			vegetation around the slag dump. Record of progressive planting of trees on dump surfaces.	/ Environmental Coordinator		budget
42	Dumping of slag material at the proposed slag dump site.	Exposure of the public to radiation through unauthorised access to the dump site.	To prevent the public from accessing the dump.	Post signage around the slag dump perimeter to warn the public of radiation and unauthorised access.	On-going	Project life	Zero incidences of unauthorised access to the dump; presence of signage warning the public against unauthorised access to the dump.	Smelter Manager / Head - Safety	20,000	Operations budget
43	Dumping of slag material at the proposed slag dump site.	Exposure of the public to radiation through unauthorised access to the dump site.	To prevent the public from accessing the dump.	Fencing off and providing tightened 24 hours security to stop possible public accessibility	On-going for provision of security.	Fencing - Prior to commencement of dumping	Fencing put in place; record of security patrols; Zero incidences of unauthorised access to the dump.	Smelter Manager / Head of Security	-	Covered under KCM Smelter / slag dump operations.

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
44	Dumping of slag material at the proposed slag dump site.	Exposure of the public to radiation through unauthorised access to the dump site.	To minimise exposure of the public to radiation after closure	Covering the slag dump surface with 30cm of soil and establish vegetation cover at closure of the dump.	As required during progressive vegetation of slag dump surface	Project life	Progressive covering slag dump surface (where no further dumping) will take place with soils.	SHE - Manager / Environmental Coordinator	1,600,000	Operations/ Decommissioning Budget
45	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Public safety risks and traffic-related accidents leading to injuries, loss of life and damage to property	To minimise public safety risks and prevent traffic-related accidents.	Haulage road will be restricted to dump trucks only.	-	Prior to commencement of dumping	Absence of pedestrians and cyclists on the haulage road	Smelter Manager / SHE Manager	-	covered in aspect no 35
46	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Public safety risks and traffic-related accidents leading to injuries, loss of life and damage to property	To minimise public safety risks and prevent traffic-related accidents.	Collaborating with local communities and responsible authorities to improve signage, visibility and over safety of roads.	As required	Operations	Improved signage observed.	SHE - Manager / Environmental Coordinator	-	Project budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
47	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Public safety risks and traffic-related accidents leading to injuries, loss of life and damage to property	To minimise public safety risks and prevent traffic-related accidents.	Embarking on community awareness aimed at reducing and sensitising the local communities and other road users on traffic and pedestrian safety and to adhere to traffic rules and regulations.	As required	Operations	Improvement on community awareness regarding road safety issues.	CSR - Manager	-	Project budget
48	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Traffic congestion on T3 and T5 resulting in traffic-related accidents.	To minimise congestion and associated impacts.	Installing road safety traffic signs at T5 crossing and any other sensitive areas. (standard signs for the purpose)	-	Prior to commencement of dumping	Presence of road safety signs installed at T5 and T3 crossing	Smelter Manager / SHE Manager	5,000	Project budget
49	Haulage of slag from smelter to the proposed dump site using access roads and crossing main trunk roads.	Traffic congestion on T3 and T5 resulting in traffic-related accidents.	To minimise congestion and associated impacts.	Installing rumble strips on either side of T5 and T3 roads to slow down traffic toward the crossing point;	-	Prior to commencement of dumping	Rumble strips installed.	Smelter Manager / SHE Manager	5,000	Project budget
50	Haulage of slag from smelter to the proposed dump site	Traffic congestion on T3 and T5 resulting in traffic-related accidents.	To minimise congestion and associated	"Trucks crossing" signs and other appropriate	-	Prior to commencement of dumping	Presence of road safety signs	Smelter Manager / SHE Manager	5,000	Project budget

Table 8.2: TD2 Slag Dump Project – Environmental and Social Management Plan										
No.	**Environmental Aspect/Issue**	**Potential Impact**	**Objectives**	**Mitigation Measures**	**Frequency of monitoring**	**Timeframe**	**Performance Indicators**	**Responsible Person**	**Cost (USD)**	**Cost Source**
	using access roads and crossing main trunk roads.		impacts.	road safety signs should be installed at T3;						
								Total	3,310,000	

Table 8.3: Environmental Monitoring Plan – Location of monitoring sites, parameters and frequency			
Location of Monitoring	**Reason for monitoring**	**Frequency of monitoring**	**Parameters to be assessed**
Effluents			
Effluent from Slag Dump (at the sump to be constructed at the proposed slag dump)	Complying with ZEMA statutory effluent discharge limits and to conform to IFC/World Bank limits.	Weekly	pH, total dissolved solids, total suspended solids, dissolved sulphate, total copper, dissolved copper, total cobalt, dissolved cobalt, total iron, dissolved iron, total manganese, dissolved manganese, electrical conductivity.
Receiving waters			
Mushishima Stream at TD3/4 Road Bridge	Assessing impact of effluent releases and diffuse releases on receiving watercourses with respect to other users and taking appropriate action based on monitoring results.	Weekly	pH, total dissolved solids, total suspended solids, dissolved sulphate, carbonates, nitrates, chlorides, total copper, total cobalt, total iron, and total manganese, total Zinc, total lead, magnesium, nickel, electrical conductivity.
Mushishima Stream at Solwezi Bridge			
Chingola Downstream;			
PCD Spillway			
Mushishima Downstream			
Chingola Upstream			
Kafue River at Hippo Pool			
Chingola Upstream.			
Ground water			
PCD Borehole	Assessing impact of seepage on receiving water body (aquifer) and taking appropriate action.	Monthly	pH, total dissolved solids, total suspended solids, dissolved sulphate, total copper, total cobalt, total iron, and total manganese, lead, arsenic, selenium, electrical conductivity.
Two new boreholes to be installed (southern and eastern flank of project site)			
Two new boreholes to be installed (western and northern flank of project site)			
Dust fallout			
Sampling point to be established on Eastern, western and southern flank of the dump site.	Assess levels of dust arising from slag dump and access road.	Monthly	Total Suspended Particles, PM10

Table 8.3: Environmental Monitoring Plan – Location of monitoring sites, parameters and frequency			
Location of Monitoring	**Reason for monitoring**	**Frequency of monitoring**	**Parameters to be assessed**
Radiation Monitoring			
New Slag Dump Site	To monitor and assess: (i) surface dose rates due to gamma radiation; (ii) surface contamination due to alpha and beta radiation.	Monthly	Gamma radiation dose rates, alpha and beta radiation dose rates
Chingola Stream (Chililabombwe Road Bridge and confluence with Mushishima Stream)			
PCD Spillway			
Hellen Bridge			
Solwezi Road Bridge at Mushishima (Control)			
Along the route to be adopted at selected points.			

Table 8.4: Incident and Accident Plan						
No.	**Hazards**	**Potential Effects**	**Objective**	**Management Action**	**Responsible Person**	**Performance Indicator**
1	Incompetent operators incapable of operating construction equipment and dump trucks in a way that is safe for them and other road users.	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring that operators at the construction site and the ones who will be hauling slag from the smelter complex to the new slag dump have the relevant experience, valid licences and are aware of KCM road safety procedure.	Safety Manager	(i) 100 per cent of operators with relevant experience and valid licenses. (ii) Zero injuries and fatalities recorded.
2	Improperly trained operators.	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring that all operators assigned to haul slag from smelter to the new slag dump have demonstrable evidence of being properly trained. If additional training is required, recommendations will be made.	Safety Manager / Training	100 per cent of operators properly trained. Zero injuries and fatalities
3	Operators not sufficiently fit and health to operate construction equipment and dump trucks safely resulting in putting themselves and others at risk.	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring operators of construction equipment and dump trucks have appropriate medical certificates, and are fit and healthy	Safety Manager	100 per cent of operators with appropriate medical certificates and zero injuries and fatalities recorded.
4	Construction equipment and dump trucks not being suitable (fit) for the purpose for which they are used.	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	All construction equipment and dump trucks involved in the construction of the slag dump and in hauling of slag from smelter to the new slag dump will have their fitness verified prior to being engaged.	Safety Manager	Record of vehicle fitness; zero incidents and accidents attributed to vehicle failures.
5	Vehicles not being maintained in a safe and fit condition.	Incidents or accidents resulting in injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring that vehicles used in the transportation of concentrates and other goods have a record of maintenance carried out to acceptable standards.	Safety Manager	Record of vehicle maintenance. Zero incidents and accidents attributed to equipment and vehicle failures.

Table 8.4: Incident and Accident Plan						
No.	**Hazards**	**Potential Effects**	**Objective**	**Management Action**	**Responsible Person**	**Performance Indicator**
6	Safety equipment not properly fitted and maintained.	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring that safety equipment such as seat belts, fire extinguishers, triangles are properly fitted and maintained in all vehicles used on-site	Safety Manager	Record of inspection of safety equipment and their status.
7	Poor road safety signage	Incidents or accidents resulting injuries or loss of life; damage to property	To prevent injuries, loss of life and damage to property	Ensuring that acceptable and reflective road warning signs and markings are put at both road crossings (T3 and T5) and along the access road to the new slag dump.	Safety Manager	Acceptable road signs installed; zero incidents and accidents attributed to poor road signage.

9 Decommissioning and Closure Plan

Decommissioning and closure principles require that a project is decommissioned and the site rehabilitated in a socially responsible manner that reflects sound environmental management practices. The decommissioning and closure phase of a project should be implemented to achieve the the following objectives:

- To protect public health and safety;
- To reduce or prevent environmental degradation; and
- To allow a productive use of the project site, similar to its original use or an acceptable alternative.

In respect of the proposed project, the decommissioning and closure activities should include activities aimed at achieving the above objectives.

The decommissioning and closure plan of the proposed slag dump is based on the assumption the dump will permanently remain at the site after decommission and closure. The slag will not be reclaimed. Based on the radiological survey results (METS, 2014), the slag contains radioactive material and the predicted annual exposure of the public to gamma radiation at the proposed slag dump was 3.54 mSv per year as compared to 1 mSv per year. The exposure pathway is through the public patronising the slag dump searching for valuable minerals.

Therefore, the slag dump will pose considerable risks to public health and safety. In order to protect public health and safety, the conceptual plan is to undertake the following activities at decommissioning and closure:

- Maintaining the fence off around the dump after decommission and closure and continuing with provision of security to stop possible public accessibility;
- Covering the slag dump surface with 30 cm of soil and establishing vegetation cover on top of the dump at closure of the dump.

Progressively rehabilitation of the dump should be undertaken to minimise public health and safety risks associated with the dump. This will also work to reduce on the decommissioning and closure costs at final closure.

KCM will prepare a detailed Decommissioning and Closure Plan for the site aimed at ensuring that decommissioning, rehabilitation and final closure of the slag dump meets defined objectives targeted at protecting public health and safety and minimising long-term environmental impacts and costs. The plan should respond to the requirements of Zambian legislations and should meet the requirements of the Equator Principles, the International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability and Vedanta Resources Plc Sustainability Governance System Technical Standard on site Closure (VED/CORP/SUST/TS 17). This is to ensure that the dump site is closed in a socially responsible manner and reflecting sound environmental management practices.

Closure costs estimate for proposed TD2 Slag Dump

The closure costs have been estimated at USD 1,595,424.05. The cost elements include the following as shown in Table 9.1:

- Earthfill capping to top surface and slopes of slag dump to a minimum thickness of 300 mm;

- Grassing and mulching to the capped surfaces;
- Earthfill toe bund wall around entire complex up to 1.5 m high;
- Install a palisade fence around entire dump complex;
- Post-closure dry season watering (2 years); and
- Post Closure independent inspections (5 years).

Table 9.1: Closure Costs Estimate for Proposed TD2 Slag Dump

Item	Description of Work	Quantity	Unit	Unit Rate (USD)	Amount (USD)
1	Earthfill capping to top surface and slopes of slag dump to a minimum thickness of 300 mm	40	ha	7000.00	280,000.00
2	Grassing and mulching to the capped surfaces	406344	m^2	0.50	203,172.00
3	Earthfill toe bund wall around entire complex up to 1.5 m high	12663	m^3	14.50	183,613.50
4	Install a palisade fence around entire dump complex	2860	m	260.00	743,600.00
5	Post-closure dry season watering (2 years)	2	Item	5,000.00	10,000.00
6	Post Closure independent inspections (5 years)	5	Item	6,000.00	30,000.00
				Sub Total	1,450,385.50
				10% Contingency	145,038.55
				Grand Total	**1,595,424.05**

10 Conclusion

This ESIS has been prepared in accordance with the requirements of applicable Zambian legislations and in conformance the requirements of the IFC Performance Standards on Social and Environmental Sustainability and Vedanta Resources Plc Sustainability Governance System. It has been prepared through a stakeholder consultation process.

The document presents the environmental and social baseline conditions of the project area. It also presents the potential environmental and social impacts and risks that are likely to arise as a result of the project. Both positive and negative impacts are presented in the document.

Mitigation measures to enhance the beneficial impacts and to avoid, reduce or remediate negative environmental and social impacts have been included in this document. Implementation of the measures will be monitored to assess their effectiveness and to adjust them where appropriate.

With the effective implementation of the proposed mitigation measures presented in this document, the construction and operation of the proposed slag dump is not likely to result in negative environmental and social impacts and risks. The project will contribute to continued operations of the smelter with the subsequent securing of employment opportunities for both KCM employees and contractors.

11 References

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Terms of Reference

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Granulated Copper Slag Materials Safety Data Sheet

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Appendix I(a)

Seismic Refraction Survey Report on TD2 Slag Dump in Chingola KCM License Area

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Appendix J

Minutes of the Public Disclosure Meeting held on 22 August 2014

Appendix K

Soils and Land Use Assessment Report

Appendix L

Social Impact Assessment Report

Appendix M

Design Report - TD2 Slag Dump