

**AN ASSESSMENT OF THE ENVIRONMENTAL  
IMPACTS OF NCHANGA OPEN PIT MINE  
IN CHINGOLA**

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## DECLARATION

I, KATONGO KABWE, declare that this report has been composed and compiled by me and that the work recorded has been done by me, that the sources of all material referred to have been specifically acknowledged, and that the project report has not been accepted in any previous application for academic award.

Signature:..........

Date:.....29 / 10 / 2004.....

## **DEDICATED**

To my late father, **LENNARD CHILESHE KATONGO** (1947 to 1998)  
for the love, care and support that he gave till he answered the Lords call.

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My gratitude can not be complete without thanking my mother, Mrs. Fridah Katongo, I owe her everything that I am.



## **ABSTRACT**

Nchanga Open Pit mine was privatized in 1998. The new owners, Konkola Copper Mines, invested about \$260 million with a view of maximizing returns on this investment. This meant that they had to reduce operation costs, a move that raised questions as to whether environmental protection was a priority. The concerns were serious because mining operations have the potential to cause air, water, land and noise pollution in the surrounding environment.

It thus became necessary to find out the nature and types of environmental impacts of mining at the open pit, the people's perception of these impacts and also the litigation and mitigation measures put in place by the mine owners. Nchanga Township was thus selected to be the study area.

Several methods were used in the collection of data which included personal interviews, direct observations, maps and literature reviews, soil and water sample analysis for pH as well as a questionnaire survey in which two questionnaires were used. A structured questionnaire was administered to 50 respondents who were randomly selected in Nchanga Township. A non-structured questionnaire was administered to key informers working at the mine.

It was found out that the mining process at the Open Pit released dust to the air. This was mainly due to blasting operations and the circulation of haul trucks on the pit roads. There was also an increase in the level of noise caused by the mining equipment and blasting operations. It was also found out that the excavations, covering an area approximately 9.46 Km<sup>2</sup> will lead to the area becoming a wasteland after the mineral deposits are exhausted. Suspended solid particles resulting from carry over of sediments with run-off from the pit slopes resulted in water contamination.

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The residents of Nchanga Township strongly felt that mining operations at the Open Pit had a negative impact on their environment. Unfortunately, the litigation and mitigation

measures of these negative impacts by management at the mine were not effective as they ignored the residential areas.

It was eventually concluded that mining at N.O.P impacts negatively on the environment in Nchanga Township and most probably Chingola as a whole. The mining operations led to lowering of the air quality, reduction in the water clarity and noise pollution.

## **CHAPTER ONE: INTRODUCTION**

### **1.1 INTRODUCTION**

Chapter one gives a brief background to the study, the statement of the problem, the purpose and objectives of the study. The Chapter further highlights the research questions, the rationale, the scope of the study as well as definitions of operational terms.

### **1.2 BACKGROUND TO THE STUDY**

While generating 85% of foreign exchange earnings, 30% of Government revenues and 15% of the G.D.P. in Zambia (Feeney; 2001), Mining has over the years impacted negatively on the environment. This is especially so on the Copperbelt Province where Copper and Cobalt ore is being mined. The negative environmental impacts are mainly through pollution which is defined as the undesirable change in the physical, chemical or biological characteristics of our air, land and water that may or will harmfully affect human life or that of desirable species (verma and Agarwar; 2001).

One way of classifying pollution around a mining activity is by considering the material that the pollutants contaminate. Thus there is air pollution and land pollution (Zambian Environmental Education Programme; 1992). The E.P.P.C.A. defines air pollution as a condition of the ambient air arising wholly or partly from the presence of one or more pollutants in the air that endangers the health, safety or welfare of persons, or that interferes with the normal enjoyment of life or property. (E.P.P.C.A. Cap 204 of 1990). Such pollution may be caused by deposited mater such as Grit, dust, smoke, fumes and aerosols. These pollutants form blue haze, cause global warming, acid rain and depletion of the ozone layer. The E.P.P.C.A. Further defines water pollution as the introduction, directly or indirectly of pollutants into an acquatic environment. Water pollution is mainly caused by the heavy metals such as copper, iron, lead and zinc, the acids, oils,

inorganic chemicals and sediments which may block streams and rivers. Land pollution is caused by solid wastes, metals as well as chemical effluents.

Poor environmental quality results from such pollution. This is of great concern in Chingola, principally due to the presence of the K.C.M. owned Nchanga open pit (N.O.P), which produces approximately 60% of the total copper output on the copperbelt (Feeney,2001).

### 1.3 STATEMENT OF THE PROBLEM

In 1998, Z.C.C.M Nchanga Division was privatized with the new mine owners estimating a total investment of \$260 million. Production was set to be increased from 180,000 tonnes/annum of copper to 220,000 tonnes/annum (Feeney; 2001) in an effort to maximize returns on their investment while on the other hand striving to reduce operational costs.

This raises questions as to whether environmental quality protection is a priority for the new mine owners. In view of the privatization of the mine, there has been a renewed threat on environmental quality in chingola.

### 1.4 PURPOSE OF THE STUDY

The purpose of the study was to investigate the impacts of open pit mining on the environment in Chingola and to assess the local people's perception towards these impacts.

### 1.5 OBJECTIVES

The objectives of the study where the following:

- To find out the nature and types of environmental impacts of mining at the open pit.
- To find out the perception of people towards the impacts of open pit mining.
- To find out the litigation and mitigation measures of the impacts of mining activities in Chingola.

## 1.6 RESEARCH QUESTIONS

In order to address variables of interest line with the objectives, the following research questions where used:-

- What is the nature and type of environmental impacts of mining at N.O.P.?
- How do the local people perceive the impacts of mining at N.O.P.?
- What are the litigation and mitigation measures that have been put in place to address the impacts of mining at the Open Pit?

## 1.7 RATIONALE

With the privatization of the Nchanga Mine, there is enormous pressure on the new owners of the mine to increase Copper production while at the same time to try as much as possible to reduce operation costs so as to get maximum returns on their investment.

It is therefore important to find out whether environment quality maintenance is a priority for the new mine owners. This is because poor environmental quality is extremely harmful to human health, has a negative impact on the quality of life in general and also has a negative effect on the ecosystem. Such impacts are especially pronounced in areas close to the mine.

This study will contribute significantly to changes in policy formulation related to environment and mining. This will be as a result of the recommendations that will be presented as well as the constructive criticism that is likely to be put across in areas where it is strongly felt that the mine owners are not adequately addressing issues related to environmental management. The study will also contribute academically to The University of Zambia (UNZA) in that it will contain current information on the impacts of Open Pit mining on the environment in Chingola.

The study will also enhance co-operation between the regulator of the environment who in this case is G.R.Z and K.C.M. who in this case may be deemed the polluter. This will be by way of highlighting the various difficulties that K.C.M. faces in managing the environment and thereby offering G.R.Z. the opportunity to intervene where necessary. G.R.Z has a social responsibility enshrined in Part IX, Cap 112(h) of the Laws of Zambia, which states that; “The state shall strive to provide a clean and healthy environment for all.” End of quote. (Constitution of Zambia: 1996). The state, through the Environmental Council of Zambia (E.C.Z.), fulfills this role by enforcing the Environmental regulations stipulated in the Environmental Protection and Pollution Control Act (E.P.P.C.A.) which is the supreme environmental Law in Zambia .

## 1.8 SCOPE OF THE STUDY

The study was focused on finding out the nature and types of the impacts on the environment that Open Pit mining at N.O.P mine in Chingola causes. The study also focused on finding out the perception of the local people on these impacts and consequently the measures that the management at the mine has put in place to counter these impacts.

## 1.9 DEFINITION OF OPERATIONAL

- (i) Blasting – This is the use of explosives to break the ground and expose the ore.
- (ii) Blue-Haze – The complex combination of carbon monoxide, sulphur dioxide, oxygen and hydrocarbons in the air to form 0 zone within the atmosphere. This harms the respiratory system on animals and injures plants.
- (iii) Bunded Areas – Concrete surfaced areas surrounded by a farrow to trap oils. These areas are used for equipment washing at the open pit garage.
- (iv) Dewatering – A process through which water is carried out by a network of pumps and boreholes from the bottom of the pits into the underground workings for subsequent pumping to surface via the mine water system.

- (v) Ecosystem – All living and non-living components of the environment that interact and influence one another
- (vi) Effluents – waste water or other fluids of domestic, agricultural, trade or industrial origin, treated or untreated, and discharged directly or indirectly into the aquatic environment
- (vii) Flotation – A process by which reagents are added to crushed copper ore in liquid form. Bubbles form and copper concentrates are able to stick to these bubbles and hence float on top. The copper concentrates can thus be extracted.
- (viii) Gyratory Crusher – Equipment used to break the copper and cobalt to a size less than 150mm. A supported metal ball swings round a fixed point to crush the ore.
- (ix) Gritt – Minute stone particles that may be blown by the wind.
- (x) Litigate – to prevent degradation of the environment.
- (xi) Milling – A process in which spherical steel balls are used in a ball-mill to reduce the ore in size to granular particles.
- (xii) Mitigate – To cushion the negative impacts of mining on the environment.
- (xiii) Mobile Equipment – Movable equipment used at the open pit such as dump trucks, front-end loaders, graders and trains.
- (xiv) Noise – Any undesirable sound that is objectionable or that can cause adverse effects of human beings, animals or the environment.
- (xv) Over Burden Material – Waste material composed of stones and soil extracted from the open pit. This material is dumped in such a way that it forms heaps.
- (xvi) Pit Sump – Lowest point of the pit where water collects.
- (xvii) Raffinate – This is a solution rich in acids formed at the tailings Leach plant (T.L.P) after extraction of copper from copper sulphate solutions.
- (xviii) Slimes – Thick slippery liquid containing copper and cobalt ore.
- (xix) Stability Period – A period in which the mine owners are only required to conduct their operations in accordance with Pollution and emission targets



agreed with by the government after negotiations. In this period, breaches of Zambia's existing environmental standards are tolerated.

- (xx) Stationary Equipment – Machinery that is not movable such as the crushers.
- (xxi) Tails – Spent or used up material from the concentrator after the first stage of copper extraction. This material is taken to the Tailings Leach Plant. (T.L.P.).

## 1.10 ORGANISATION OF THE REPORT

This report is divided into seven chapters. It starts with chapter one which is followed by chapter two. Chapter two outlines the summary of literature on open pit mining as it impacts on the environment. Chapter three gives a description of the study area. The Chapter contains the description of the location, climate, hydrology, population and housing and the state of Nchanga open pit mine. Two maps have been used in this chapter. Chapter four primarily highlights all the methods used in data collection:- Questionnaire surveys, personal interviews, direct observations, maps and literature reviews as well as soil and water sample analysis. Data processing and presentation as well as the constraints of the study are given in this chapter. Chapter five is a presentation of the findings of the study. These findings have been presented in a logical manner to provide meaning to the reader. Tables and figures have been employed to enhance clarity. The sixth chapter is a discussion of the findings. The implications of these findings and the study constraints have also been discussed. Chapter seven summarises the findings of the study which are presented as concluding remarks. The Chapter also contains recommendations as well as suggested topics for future research on the impacts of mining on the environment.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 INTRODUCTION**

Many environmental issues arose from mining activities prior to 1980, when little attention was paid to the environmental impacts of mining activities in Zambia. Pollution and environmental degradation and their impacts on public health and ecosystem functions, were considered to be an acceptable trade-off given the economic benefits and jobs provided by mining. This changed, as civil society and government became increasingly aware of the need to mitigate the long term environmental impacts of industrial activities, to maintain quality of life. However, the poor economic performance of the mining sector in Zambia in the 1980's and 1990s led to increasingly inadequate handling of environmental issues arising from mining activities. As a result, as the World Bank puts it, "a massive environmental mortgage accrued that needed to be addressed once the decision was taken to privatize mining assets."

The mines that have since been privatized on the Copperbelt include the former Zambia Consolidated Copper Mines (ZCCM) Nkana Division, Luanshya Division, Mufulira Division and Nchanga Division which is now being run by the Konkola Copper Mines Plc. This particular mine located in Chingola has an underground facility as well as an open pit facility. N.O.P. was commissioned way back in 1955 for the production of Copper and Cobalt ore. It has since been the main open pit facility at Nchanga Mine and currently produces approximately 5 metric tonnes of Copper ore, 1 metric tonne of Copper/Cobalt ore and 78 metric tonnes of over-burden material annually. (KCM; 2002).

### **2.2 ENVIRONMENTAL IMPACT ASSESSEMENT OF N.O.P.**

According to AMEC Earth and Environmental Limited and KHANYA, who carried out an environmental assesement at N.O.P. Mine in April 2001, the main environmental issues highlighted were firstly the release to water from dewatering operations. The quality of water pumped to the underground was and is still a potential concern due to the high concentration of suspended solids that result

from carry over of sediment with run-off from the pit slopes. This water has a potential presence of fuel and oil in the event of an accidental release in the pit and a concentration of metals associated with the suspended solids fractions resulting from the solubilisation of metals due to acid rock drainage of exposed pit wall materials.

The second environmental concern highlighted by the report was the contamination of soil caused by fuel, oil and ore through spillage of fuel at the in-pit mobile fuel tank, storage of ore in non-designated areas, spillage of ore during transportation from the mining area to the processing plant and inadequate disposal of silt material accumulated in the pit sump.

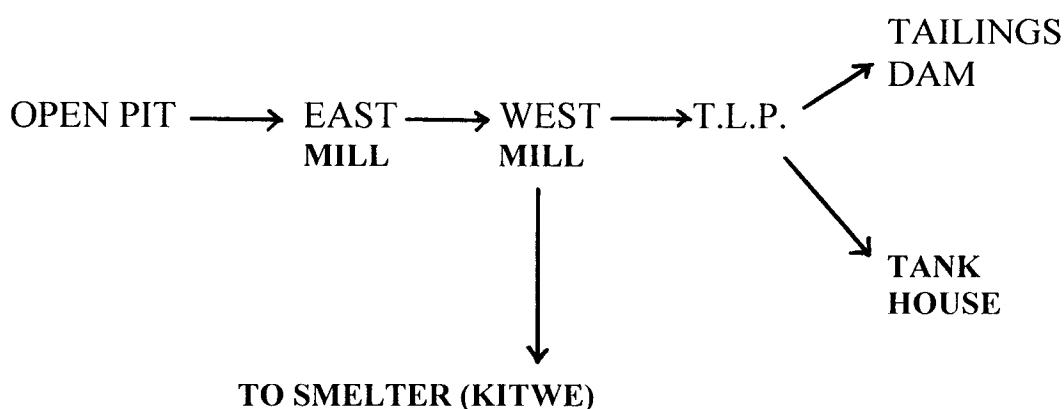
Soil and water contamination at the open pit workshops as a result of equipment washing in unbunded areas was also of great concern. This can lead to release of oil to the soil and into the drainage system.

The third environmental concern was the release of dust emissions to air. Especially in the dry season (July-November) the blasting operations carried out in order to break up the ore constitute an uncontrolled release of dust to air. The circulation of haul-trucks on the pit roads to transport the ore from the pit to the plant also generate dust as the pit roads are only temporary and therefore unsurfaced. The loading and off-loading of ore from the haul trucks also raises dust.

## 2.3 COPPER AND COBALT PROCESSING

These are extremely genuine environmental concerns. However, one can not avoid assuming that there are more concerns. The process of Copper and Cobalt production can be divided into two stages. Firstly, the actual mining which is done in the pits and secondly the processing which is done within the plant. Environmental concerns are not confined to the mine alone but are very likely to spill over to the households/residential areas located near the mines.

Possible compromise of the environmental quality starts at the first stage of production which is the mining at the pits. Each stage in the chain of production has its possible environmental concerns. According to the KCM annual report of 2002, a summary of this process is as follows:



Operations at the pit are carried out 24 hours per day per week on a four swing shift basis. The pit is mined in benches averaging 15m high with access ramps 35 to 50m wide at 8% gradient. Copper ore is mined from 3 ore bodies, the lower, the intermediate and upper ore bodies. Blasting operations are carried out in order to break up the ore. Loading of the blasted ore and waste is carried out by P&H shovels. Caterpillar front-end loaders are used for stock-piling and separating the ore and the waste at the loading sites. Hauling of the ore and waste is undertaken using Wabco and Dresser 109 tonne, Komatsu 177 tonne diesel-electric trucks and with caterpillar 177 tonne mechanical trucks.

These surface mining operations may quickly transform a scenic area of breath taking beauty into an ugly wasteland (Owen; 1985). Furthermore, these operations a lot of dust which has the potential to go as far as the surrounding residential area. This lowers the air quality and increases the chances of miners and local people contracting respiratory diseases. The E.P.P.C.A. prohibits such

type of air pollution, under section 39 of the Act. (E.P.P.C.A – Cap 204 of 1990). The blasting operations also produce noise.

The ore from the pit is delivered to the Eastmill situated on the southern side of the pit. Here, there is a gyratory crusher. The ore first undergoes primary crushing and is then washed so as to separate the coarse ore from the sands and slimes.

The coarse ore then undergoes Secondary and tertiary crushing and is reduced to less than 150mm. On the other hand the sands and slimes are separated and the sand is mixed with the ore from the tertiary crusher and sent for milling. The slime is thickened. The milled ore and the thickened slime are transported by pipeline to the West mill for flotation.

Cobalt ore which is mined from selected areas within the pit is trucked to a similar but separate gyratory crusher installed on the South Western side of the pit. From there, the crushed cobalt ore is transported by rail to a processing circuit situated in the West mill plant.

Lungu (2004), in his report indicated that this process of crushing produces a lot of dust and lowers the quality of the air. Furthermore, the crushers produce a lot of noise especially for the nearby single quarters (Sq) which are a part of Nchanga North township. These houses were originally meant for single miners but due to the housing shortage, most of these single quarters are occupied by married miners with an average family of about six to seven members.

The process of flotation is done at the Westmill. This is the process that separates the Copper oxides and the Copper sulphides from the pure copper concentrates. Reagents are added to the copper ore and slimes. The tails contain the oxides and sulphides settle at the bottom and the material rich in copper floats on top. The tails are sucked from the bottom and sent to the T.L.P meanwhile. The copper

concentrate is thickened and separated into high grade and medium grade concentrates and transported to the smelter located in Kitwe.

## 2.4 ENVIRONMENTAL CONTAMINATION

Lungu (2004) highlights in his report, the possible contamination of the environment with the chemicals contained in the reagents used in the process of flotation. These reagents include lime to reduce the PH, sulphide frother, potassium anyl xanthate, sodium hydro-sulphide and oxide frother.

According to verma and Agarwal (2001), high levels of sulphur or its compounds that find themselves in acquatic ecosystems have the potential to cause destruction of acquatic organisms. Furthermore, the presesence of compounds of potassium and sodium in huge quantities in acquatic ecosystems equally leads to a high mortality rate of acquatic life forms.

In his monthly report, Chungu (2001) indicated that the T.L.P. receives tailings from the concentrator at the West mill. Leaching of the tailings is done by adding concentrated sulphuric acid. The acid is added at the primary tailings leach pachucas at a rate of 500 tones per day together with compressed air to facilitate the leaching process. The main interest at this stage is the recovery of the solvent rich in Copper Sulphate.

The Copper Sulphate solution is then sent to the solvent extraction plant where an organic chemical is added to strip off the copper solution. This leaves a solution called Raffinate which is re-introduced into the system and is again leached. The copper solution is sent to the tank-house for the process of electrolysis where pure copper is obtained. The effluents are treated and neutralized by adding lime before being transported by pipeline to Muntimpa Tailings dam where the pH is monitored before being disposed off.

The main environmental concern at this point is as a result of the sulphuric acid used in leaching the tails. It is possible that there may be accidental acid spillages either due to inadequate handling facilities or negligence in handling. The acids have the capacity to dissolve in water and may seep through the ground and lower the pH of the underground water resources that later re-surface as surface water resources. Sulphuric acid also raises the sulphur content of the water.

Mcfadden (1995), brings to light the fact that certain aquatic organisms thrive in acidic waters while others thrive in alkaline waters. Sudden and considerable changes in these parameters could be very fatal to these organisms.

According to management at Konkola Copper mines Plc. The notable improvements aimed at reducing pollution at the mine will include:

- Provision of impervious surfacing and containment for hazardous material storage and handling areas such as fuel stations and workshops.
- Installation of oil traps on drainages from areas which are subject to accidental releases of hazardous material.
- Development of emergency response plans.
- Disposal of historical waste and establishment of dedicated industrial waste storage areas.
- Construction of erosion and storm water management infrastructure.
- 

## 2.5 ENVIRONMENTAL LAWS IN ZAMBIA

The E.P.P.C.A. No. 12 of 1990 (Cap 204 of the Laws of Zambia) is the supreme environmental law in Zambia and it prescribes the functions of the E.C.Z. as a corporate body. The E.C.Z. draws up and enforces regulations related to water, air, land and noise pollution as well as advising government on the formulation of environmental policies. The environmental council regularly conducts

inspections and compliance monitoring activities aimed at protecting the environment and controlling pollution.

However, under the development agreement for mine privatization GRZ has granted a 15 year stability period for all privatized mines with the exception of KCM, which has been granted an extraordinarily generous 20 years stability period (Feeney;2001). This means that during the stability period, the new owners are only required to conduct their operations in accordance and within the agreed pollution and emission targets set in their Environmental Management Plans. In other words, breaches of Zambia's existing environmental standards will be tolerated.

According to the summary of project information, for the duration of the stability period, GRZ has limited authority to enforce environmental laws: It will not impose fines or penalties (unless emissions exceed the licenced higher levels) nor will it make changes to Zambian mining-environment legislation. GRZ will refrain from imposing requirements that are more onerous than those specified in the environmental management plans.



## CHAPTER THREE

### 3.1 INTRODUCTION

The main focus of this chapter is the description of the study area. The climatic conditions, the hydrology, the population distribution and housing and the land tenure classification of Chingola is discussed. The state of N.O.P. is also considered.

### 3.2 LOCATION

The study area is Nchanga Township which is located within Chingola Town approximately 51Km west of Kitwe on the Copperbelt province. (figure 1). Nchanga is situated between latitude  $12^{\circ} 30'S$  and  $12^{\circ} 35'S$ ; Longitude  $27^{\circ} 50'E$  and  $28^{\circ} 30'E$  and lies at an altitude of 1300m above sea level (C.S.O.; 2003).

Nchanga Township shares its northern boundary with the KCM owned Open Pit mine. The township is divided into Nchanga North and Nchanga South. Approximately, it lies within a 3km radius from the Open Pit mine.

### 3.3. CLIMATE

Nchanga Township experiences tropical climate with a marked summer rainfall between November and April; A cold dry season between April and August and a hot dry season between August and November. The area receives an annual rainfall of about 1200mm and mean daily temperature ranges from  $17^{\circ}C$  to  $23^{\circ}C$ .

The high rainfall leads to increased surface run-offs between November and April. These surface run-offs have the potential to transport pollutants from one point to another.






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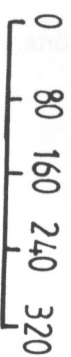
# LOCATION OF CHINGOLA: WITHIN ZAMBIA AND WITHIN THE COPPERBELT PROVINCE.



## LEGEND

-  Copperbelt province .
-  Location of Chingola .
-  International boundary .
-  Provincial boundary .
-  Capital city .

## SCALE



### 3.4 HYDROLOGY

The area falling within Nchanga Township and immediately beyond its boundaries is built on a high rock with one river and three streams. These are the Kafue River, Nchanga underground stream, Chingola stream and the Muchinshi stream found in the North Western direction. (C.S.O.; 2003).

These surface and underground waters absorb the effluents that result from mining. Such effluents may include metals (Copper, Zinc, Lead, Mercury) Phenols, Carbonates, Alcohols, Cyanide, Arsenic, Chlorine and many other toxicants. These may cause death or sublethal pathology of the liver, kidneys, reproductive systems, respiratory systems and nervous systems of both invertebrate and vertebrate aquatic animals (Wilbur; 1969).

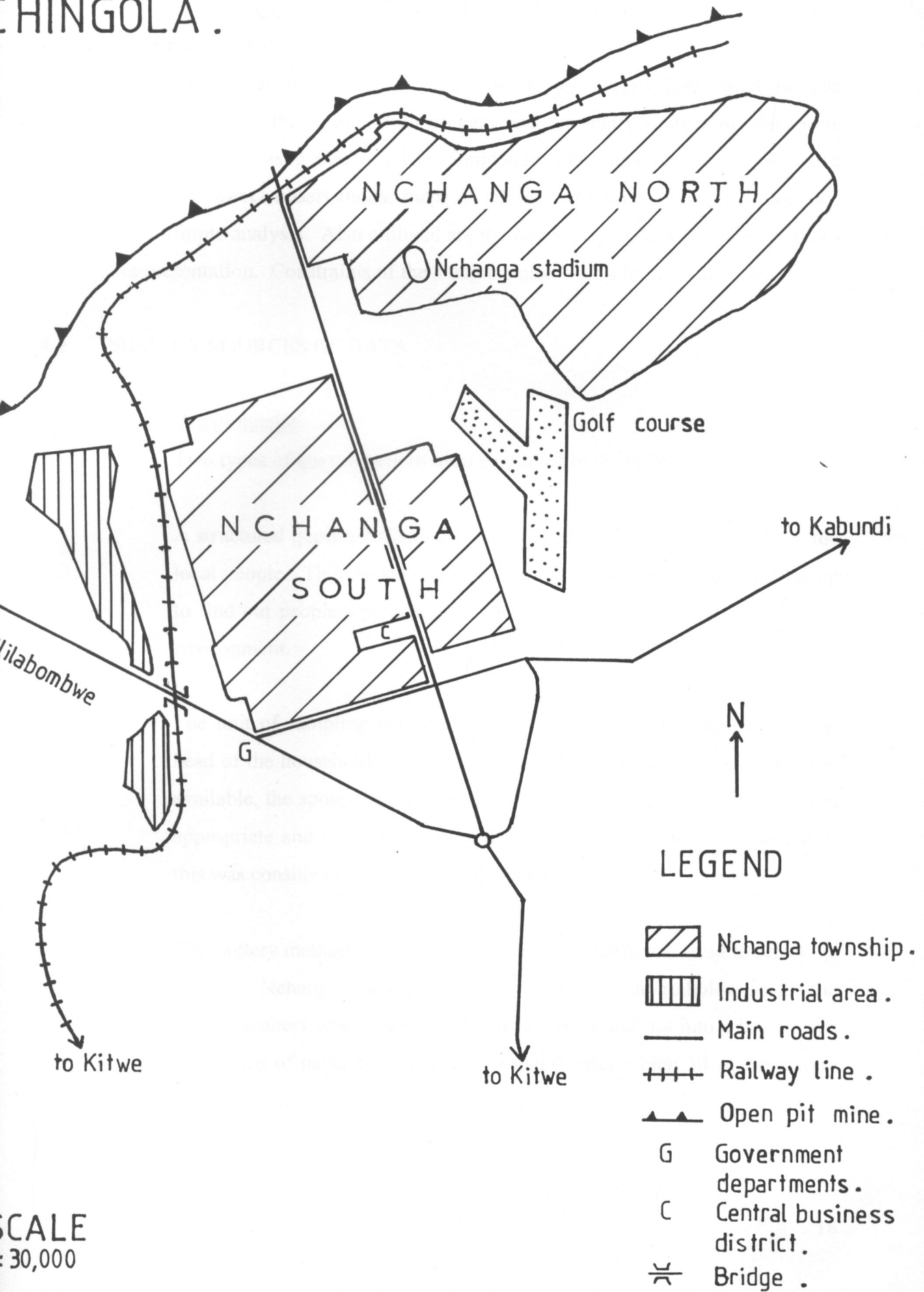
### 3.5 POPULATION AND HOUSING

According to the 2000 census of housing and population, the entire Chingola town has a population of 75,806. Nchanga Township alone has a population of 13,820 with 51.2% males and 48.8% females. The township has a total number of 2,072 households. 948 of these households are in Nchanga South which is a low density section while Nchanga North which is a high density Section has 1,124 households. (figures 2).

### 3.6 STATE OF THE MINE

N.O.P. mine is the main open pit facility at Nchanga Mine and it's current size now reaches approximately 4.3 Km in length by 2.2 Km in width by 405m in depth. It is the second largest Open-pit facility in the world and produces 60% of the total Copper and Cobalt production on the Copperbelt. (K.C.M; 2002)

# LOCATION OF NCHANGA TOWNSHIP IN CHINGOLA.



## **CHAPTER FOUR: METHODOLOGY**

### **4.1 INTRODUCTION**

This chapter primarily aims at highlighting all the methods used in data collection during the study. Both primary and secondary sources of data were used. The following methods were employed; Questionnaire survey; personal interviews; direct observations; maps and literature reviews as well as soil and water sample analysis. Also outlined are the methods of data processing, analysis and presentation. Constraints of the study are also highlighted in this chapter.

### **4.2 PRIMARY SOURCES OF DATA**

#### **4.2.1 Questionnaire**

Two types of questionnaires were employed in the collection of data:-

A structured questionnaire (Appendix I) was used to collect data from the local people. This questionnaire was administered in Nchanga Township to find out people's perception of the impacts of open pit mining on the environment.

The unit of sampling was the household, and the study sample was the head of the household. In cases where the head of the household was not available, the spouse was interviewed. Random sampling was considered appropriate and was thus employed. A sample size of 50 was picked as this was considered to be statistically sound.

The Lottery method, as prescribed by Ghosh (2000), was used to select the sample. Nchanga township has a total of 2,072 households, so all the house numbers were written on slips of paper and put into a box. Then these slips of paper were mixed thoroughly after which 50 of them were drawn.

The rationale for using random sampling was that every member of the population was accorded the same chance of being selected. The selection was entirely objective and free from any form of bias. It thus produced a representative sample.

A non structured questionnaire (Appendix II) was employed in the collection of data from key informers working for K.C.M. purposive sampling was employed because very specific data was being sought and not everybody working for K.C.M. had access to this data. The universe therefore was not well defined. It was thus necessary to administer the questionnaire only to respondents who had the relevant data. This was an open questionnaire so as to allow for the collection of new ideas and facts.

#### 4.2.2 Personal Interviews

Personal interviews were conducted with officials from the Ministry of Mines and Minerals Development, E.C.Z., Central Statistics office (Chingola), Chingola District Health Board, Mulonga water and Sewerage, Chingola Municipal Council (C.M.C) and Nchanga South township offices. These interviews were mainly to inquire about the information that could not be captured through the use of questionnaires.

#### 4.2.3 Direct Observations

Direct observations were also employed in data collection. This method assisted in collecting qualitative information that could not be captured through the questionnaire surveys.

#### 4.2.4 Soil and Water Sample Analysis

Two water samples were collected on the Kafue river downstream after the point at which treated effluents from the mine are

introduced into the river. Those were analysed with the aim of determining the pH.

Two compound soil samples were also collected and analysed for the pH. The first compound sample comprising of 8 separate soil samples was collected from Nchanga South, while the second compound sample also comprising of 8 separate soil samples was collected from Nchanga North. The 50 households earlier selected randomly for administering of the questionnaire acted as a sampling frame for random sampling of houses at which soil samples were collected.

PH values may be used as an indication of soil and water pollution especially from toxic substances such as acids.

#### 4.3 SECONDARY SOURCES OF DATA

Secondary sources of data that were used included maps from Central Statistics Office (C.S.O.) and C.M.C. Available literature on Open Pit Mining as it impacts on the environment was consulted and is presented in Chapter 2. The reference section outlines the sources of this literature.

#### 4.4 PRE-TEST

In my view, pre-testing of questions or use of pilot studies may save a great deal of time by validating the questions to check whether they are relevant or useful to give the information required. The questionnaire was thus pre-tested in Kabundi North Township which has a similar setting with Nchanga Township with respect to the proximity to the Open Pit, the climate, the population and housing distribution. This led to the removal and inclusion of some questions while other questions were re-phrased.

#### 4.5 DATA PROCESSING, ANALYSIS AND PRESENTATION

The data collected in this study was processed using the coding system. The data was analysed manually and then tabulated so as to enable the calculation of percentages of the responses. The analysed data is presented in the form of maps, charts, tables and graphs.

#### 4.6 STUDY CONSTRAINTS

In the course of executing the study, various constraints were encountered. These affected the findings presented in Chapter 5 and are outlined below:

- It was extremely difficult to gain access to the open pit. However, after several days of trying, it was possible to gain permission but even then, permission to take photographs was denied. Photographs would have provided a visual presentation of some of the findings.
- An ideal situation would have prevailed if a sample comprising of 10% of the sampling frame or more was collected, as that would have been more representative. Time, logistical and financial factors could not permit that.
- The non-structured questionnaire (Appendix II) was administered to respondents while they were in the midst of other activities and could have thus answered the questions in a hurry hence affecting the quality of responses.



## **CHAPTER FIVE: RESEARCH FINDINGS**

### **5.1: INTRODUCTION**

This chapter contains the findings of the study. It incorporates the information obtained from interviews with management at K.C.M, the questionnaire administered in Nchanga Township, tests for the pH carried out on water and soil samples and observations that were made. The findings have been presented in a logical manner to provide meaning to the reader.

### **5.2: NATURE AND TYPES OF ENVIRONMENTAL IMPACTS**

The main environmental impacts resulting from mining at the open pit are the following;

#### **5.2.1: UNCONTROLLED RELEASE OF DUST TO THE AIR.**

There is uncontrolled release of dust to the air, firstly due to the blasting operations carried out in order to break up the ore in the pit. Secondly the circulation of haul trucks on the pit roads to transport the copper and cobalt ore from the pit to the crushers; and thirdly, the off-loading of ore from haul trucks. These dust emissions are mainly in the dry season when the soil has lost its moisture.

A physical check on the vegetation found near the open pit, revealed that there was a lot of dust that had settled on the leaves.

#### **5.2.2: INCREASED LEVEL OF NOISE**

A lot of noise is generated from three major sources; Mobile equipment, plant machinery and blasting operations. Operations at the mine are carried out on continuously and so this noise persists 24 hours a day everyday.

#### **5.2.3: SOIL CONTAMINATIONS AND LAND DEGRADATION**

Soil contamination as a result of mining at the open pit is mainly caused by accidental spillages of fuel, ore and acids such as sulphuric acid. Inadequate disposal of silt material also contaminates the soil. It was also observed that the excavations have produced huge holes or pits into the ground, which will not be used for anything else when the copper and cobalt ore reserves have been exhausted

very large area covering approximately 9.46 KM<sup>2</sup> is going to become a wasteland. Tests for soil pH carried out on two compound samples from Nchanga North and South Township gave the following results;

**Table 1: pH values for compound sample from Nchanga North.**

| SAMPLE  | pH VALUE |
|---------|----------|
| 1       | 8.11     |
| 2       | 7.04     |
| 3       | 5.08     |
| 4       | 6.87     |
| 5       | 6.10     |
| 6       | 5.00     |
| 7       | 5.16     |
| AVERAGE | 6.19     |

The average pH was 6.19 and the range was observed to be from 5.00 to 8.11.

**Table 2: pH values for compound soil sample from Nchanga South.**

| SAMPLE  | pH VALUES |
|---------|-----------|
| 1       | 6.23      |
| 2       | 6.09      |
| 3       | 5.00      |
| 4       | 5.45      |
| 5       | 5.27      |
| 6       | 5.20      |
| 7       | 5.73      |
| 8       | 6.15      |
| 9       | 5.93      |
| AVERAGE | 5.89      |

The pH range was observed to be from 5.00 to 7.20 and the average pH was 5.89.

Using the T-test (APPENDIX III), it was found out that there was no significant difference between the means of the pH values in the samples from Nchanga North and Nchanga South.

5.2.4: WATER CONTAMINATION

The water pumped to underground contains suspended particles that result from carry-over of sediments with run-off from pit slopes. This water also contains a concentration of metals, oils and fuel. It enters Nchanga Underground stream, which drains into the Kafue River.

Tests on two water samples water samples were carried out in order to detect whether the acids used in the extraction of copper oxides and copper sulphides at T.L.P affect water pH in the Kafue river, downstream after the point at which effluents are discharged.

Table 3: pH values for water samples at a point downstream Kafue river after effluents have been introduced.

| SAMPLE  | pH VALUE |
|---------|----------|
| 1       | 7.87     |
| 2       | 7.56     |
| AVERAGE | 7.72     |

5.3: LOCAL PEOPLE’S PERCEPTION OF THE ENVIRONMENTAL IMPACTS.

There was a 100% response rate in that all the 50 prepared questionnaires were answered. The distribution of the respondents’ personal details that might have affected their responses was as follows. This was based on data collected in the field.

Table 4: Percentage distribution by sex.

| RESPONSES | FREQUENCY | PERCENTAGE (%) |
|-----------|-----------|----------------|
| Male      | 18        | 36             |
| Female    | 32        | 64             |
| TOTAL     | 50        | 100            |

Table 5: Percentage distribution by age range.

| AGE RANGE (Yrs) | FREQUENCY | PERCENTAGE( % ) |
|-----------------|-----------|-----------------|
| Below 30        | 10        | 20              |
| 30 to 40        | 23        | 46              |
| 41 to 50        | 11        | 22              |
| Above 51        | 6         | 12              |
| <b>TOTAL</b>    | <b>50</b> | <b>100</b>      |

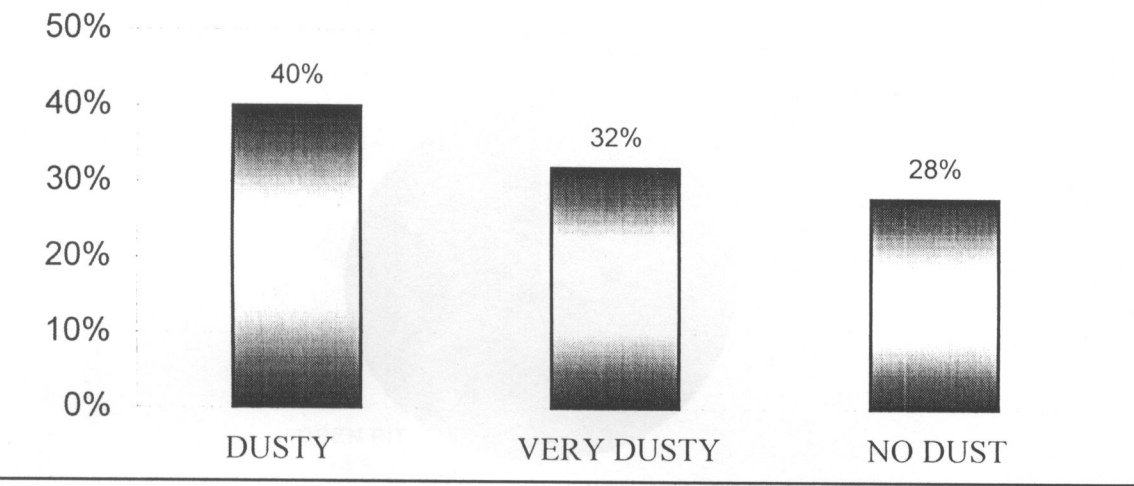
Table 6: Percentage distribution by level of education.

| RESPONSES    | FREQUENCY | PERCENTAGE( % ) |
|--------------|-----------|-----------------|
| None         | 4         | 08              |
| Primary      | 7         | 14              |
| Secondary    | 23        | 46              |
| Tertiary     | 16        | 32              |
| <b>TOTAL</b> | <b>50</b> | <b>100</b>      |

Table 7: Percentage distribution by length of stay in Nchanga Township.

| RESPONSES      | FREQUENCY | PERCENTAGE( % ) |
|----------------|-----------|-----------------|
| Below 1 year   | 2         | 04              |
| 1 to 10 years  | 25        | 50              |
| 11 to 20 years | 15        | 30              |
| Above 20 years | 8         | 16              |
| <b>TOTAL</b>   | <b>50</b> | <b>100</b>      |

Figure 3: Shows the peoples' perception of the levels of dust



SOURCE: Data collected in the field.

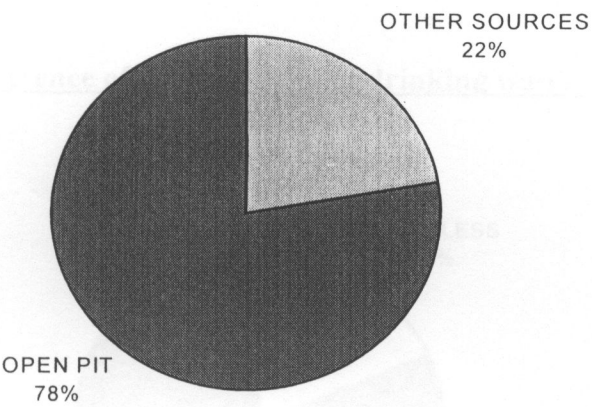
**NO DUST**- There were no dust particles in the air.

**DUSTY**- Dust noticed usually after a week on household furniture, appliances and windows.

**VERY DUSTY**- Dust that can even be noticed in the air with the naked eye.

40 % of the respondents consider the area to be dusty, while 32% said that it was dusty. The remaining 28% of the respondents said that there was no dust around their households.

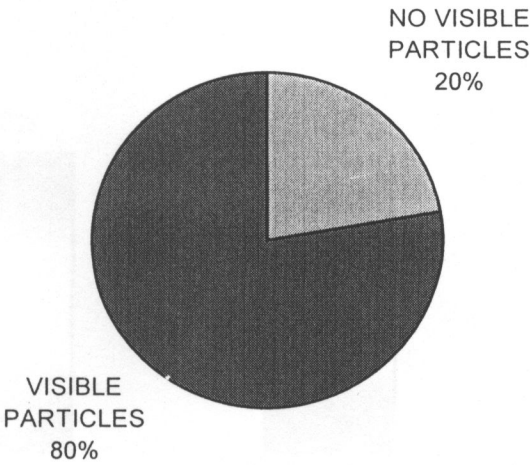
Figure 4: Shows the perceived sources of dust.



SOURCE: Data collected in the field.

The majority of the respondents comprising of 77.78% were convinced that the dust comes from the mining operations at N.O.P, while the remaining 22.22% felt that the dust comes from other sources other than the pit.

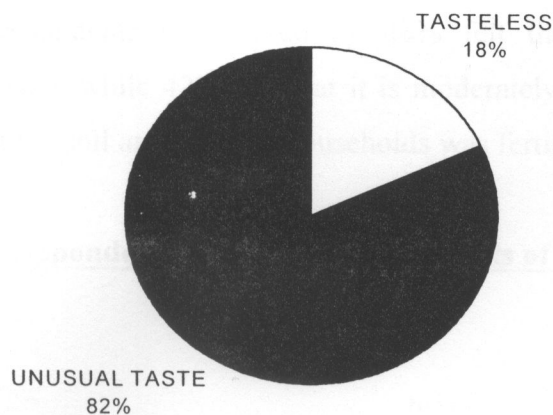
Figure 5 ; Shows the observed presence of visible particles in drinkingwater.



SOURCE: Data collected in the field.

It was observed that 80% of the respondents were able to see visible particles suspended in their drinking water while 20% said that the drinking water was clear.

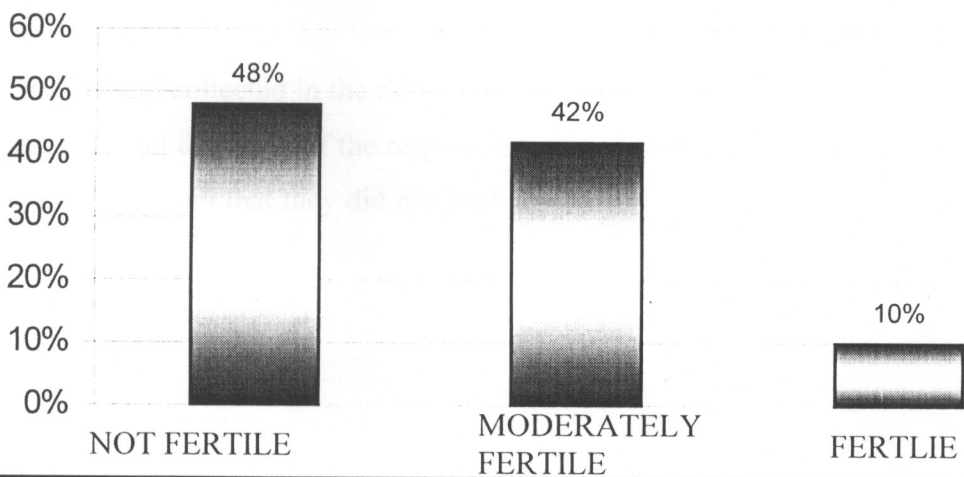
Figure 6: Shows the presence of unusual taste in drinking water.



SOURCE: Data collected in the field.

The majority of the respondents represented by 82% said that the drinking water did not posses any unusual taste while the remaining 18% said that the water had an unusual taste.

Figure 7: How respondents feel about the fertility of soil around their households



SOURCE: Data collected in the field.

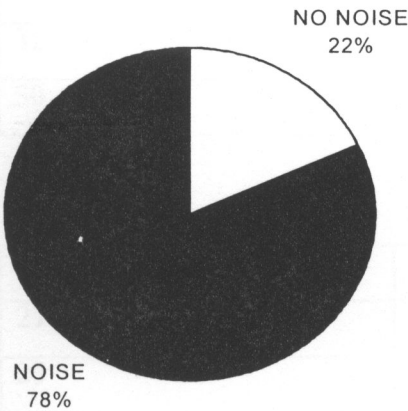
**FERTILE SOIL** - Soil in which the respondents where able to grow more than one type of crop without applying inorganic fertilisers.

**MODERATELY FERTILE** – Soil in which the respondents were only able to grow one type of crop without applying inorganic fertilisers.

**NOT FERTILE** – Soil in which the respondents could not grow anything without applying inorganic fertilisers.

The majority of respondents represented by 48% felt that the soil around their households is not fertile, while 42% felt that it is moderately fertile. Only 10% of the respondents said that the soil around their households was fertile.

Figure 8: Shows the respondents' perception of the levels of noise from N.O.P.



SOURCE: Data collected in the field.

It was found out that 78% of the respondents get a lot of noise from N.O.P while 22% of the respondents said that they did not hear any noise.



### Sources of noise as perceived by the local people.

The residents of Nchanga Township could hear noise from N.O.P. made by different sources, namely mobile equipment, plant machinery and blasting operations.

Table 8: Mobile equipment;

| RESPONSES    | FREQUENCY | PERCENTAGE (%) |
|--------------|-----------|----------------|
| YES          | 32        | 64             |
| NO           | 18        | 36             |
| <b>TOTAL</b> | <b>50</b> | <b>100</b>     |

Table 9: Plant machinery;

| RESPONSES    | FREQUENCY | PERCENTAGE (%) |
|--------------|-----------|----------------|
| YES          | 18        | 36             |
| NO           | 32        | 64             |
| <b>TOTAL</b> | <b>50</b> | <b>100</b>     |

Table 10: Blasting;

| RESPONSES    | FREQUENCY | PERCENTAGE (%) |
|--------------|-----------|----------------|
| YES          | 27        | 54             |
| NO           | 23        | 46             |
| <b>TOTAL</b> | <b>50</b> | <b>100</b>     |

SOURCE; Data collected in the field.

With respect to mobile equipment, 64% of the respondents acknowledged as being a source of noise while 36% said that they did not hear any noise from mobile equipment. On plant machinery, 36% said that it was a source of noise of noise while 64% said that it was not a source of noise. With respect to blasting operations, 54% of the respondents said that it was a source of noise while the remaining 46% disputed this.

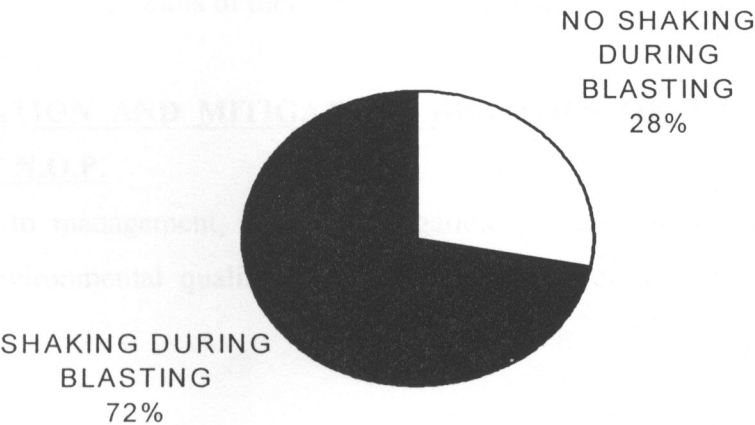
Table 11: Times of the day when the respondents hear the noise from N.O.P.

| RESPONSES              | FREQUENCY | PERCENTAGES (%) |
|------------------------|-----------|-----------------|
| 06:00 hrs to 18:00 hrs | 12        | 30.8            |
| 18:00 hrs to 06:00 hrs | 8         | 20.5            |
| 24 hours a day         | 19        | 48.7            |
| TOTAL                  | 39        | 100             |

SOURCE: Data collected in the field.

The majority of the respondents represented by 48.7% are able to hear the noise 24 hours a day while 30.8% only hear the noise during daytime. The remaining 20.5% responded that they hear the noise only at night.

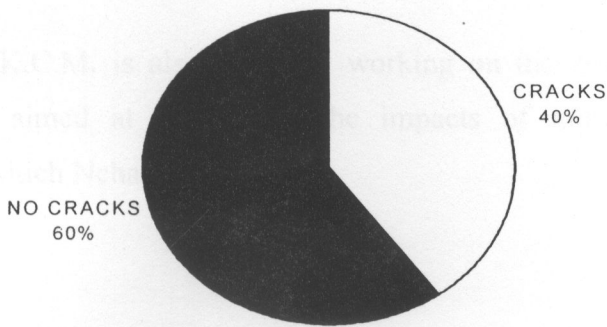
Figure 9: Shows households that shake during blasting.



SOURCE: Data collected in the field.

It was found out that 72% of the respondents are able to feel their houses shake during blasting, while the remaining 28% said that their houses do not shake during blasting.

Figure.10: Shows households that have cracks on the walls.



SOURCE: Data collected in the field.

A total of 60% of the respondents said that the walls of their houses do not have cracks while 40% said that the walls of their houses have cracks

**5.4: LITIGATION AND MITIGATION MEASURES OF THE IMPACTS OF MINING AT N.O.P.**

According to management, the main litigation and mitigation measures aimed at improving environmental quality include the provision of impervious surfacing and

containment for hazardous material storage and handling areas such as the fuel stations and workshops. This is intended to reduce soil contamination by fuel, oil and hazardous materials such as highly concentrated acids. Oil traps are being installed on drainages from areas such as fuel stations and workshops, a move aimed at preventing the fuel from contaminating underground water resources. Further, the company has embarked on the disposal of historical waste and establishment of dedicated industrial waste storage areas. The company has also constructed erosion and storm water management infrastructure.

Management at K.C.M. is also currently working on the development of emergency response plans, aimed at cushioning the impacts of mining on the surrounding environment of which Nchanga Township.

## **CHAPTER SIX: DISCUSSION**

### **6.1 INTRODUCTION**

This chapter is focused on the understanding of the results presented in Chapter five and provides a critical appraisal in relation to the issues highlighted in the literature review. The constraints of the study as well as the strengths will equally be discussed.

### **6.2. AIR CONTAMINATION RESULTING FROM DUST**

The task of quantifying the levels of dust in the air is not an easy one, thus it has to be described in qualitative terms. According to the literature view, there is an uncontrolled release of this dust to air primarily due to mobility of mining equipment compounded by the fact that the pit roads are un surfaced (K.C.M.; 2002). This dust was observed to travel long distances in the air and often went as far as the households in Nchanga Township. The majority of the respondents in the township represented by 40% said that the air was dusty. It was observed that the people who said that the air was very dusty are those who live nearest to the open pit. 14% of the respondents felt that there was no dust in the air, these live further away from the open pit. This is so because the concentration of dust must be highest at source and reduce as the particles move through the air probably because some dust has to settle. An observation of the leaves of vegetation displayed the same pattern with the vegetation nearest to the pit having more dust on the leaves than the vegetation further away. 77.78% of the respondents felt that this dust comes from the mining operations at the open pit, a fact that management at K.C.M. did not dispute. The pit roads are watered so as to reduce on the levels of dust but this obviously is not producing the desired results. In spite of such watering, the levels of dust are still very high especially between July and November when clouds of dust can be seen floating in the air.

The main impact on the population of Nchanga Township is that this dust is a health hazard as it contributes to the prevalence of respiratory problems. This is

shown by the revelation that 78% of respondents frequently (i.e. almost every month), suffer from coughs especially in the dry season, which coincides with the period, according to literature, when the levels of dust are said to be highest.

### 6.3 WATER CLARITY AND pH

According to the literature,(K.C.M.; 2002), the quality of water pumped to the underground was and is still a potential concern due to the concentration of suspended solids that result from carry over of sediments with run-off from the pit slopes. The water that is pumped to the households is treated by A.H.C. mining municipal services but unfortunately, 80% of the respondents samples in the study, observe suspended particles in the water. K.C.M. is definitely pumping water that contains a concentration of suspended solids to the underground. This water enters the Nchanga underground stream, which empties it's waters into the Kafue river. Even after being treated, the water still retains some of these particles. 20% of the respondents said that there were no suspended particles in the water. This was strange, because the whole Nchanga Township together with other townships like Kabundi and Lulamba, get their water from the same source. This 20% comprised of male heads of households who are either currently working for K.C.M. or are retired. The strong feeling of the researcher is that these respondents were biased towards K.C.M.

The main impacts of the suspended solid particles in drinking water are related to the prevalence of diarrheal diseases. 44% of respondents said that their family members frequently suffer from diarrheal diseases, while 56% said that their family members did not frequently suffer from diarrheal diseases. 100% of the respondents whose families frequently (i.e. almost every month) suffer from diarrheal diseases, blamed it on the drinking water.

The average water pH was found to be 7.715 which falls within the parameters recommended by W.H.O. guidelines for drinking water i.e. 6.5 to 8.5. management at K.C.M said that waste water especially from T.L.P. is treated and

neutralised with lime to control the pH, In this regard, the pH of the water is adequately maintained at levels suitable for human consumption.

#### 6.4 SOIL DEGRADATION AND FERTILITY

Measurements of the soil pH were taken so as to give an indication of the soil fertility around households in Nchanga Township. The pH in Nchanga North ranged from 5 to 8.11 with an average of 5.89 while the pH of Nchanga South ranged from 5 to 7.20 with an average of 5.89. Generally, these pH values were close to the neutral value of 7 and thus it was observed that the soil was neither too acidic nor alkali.

48% of the respondents felt that the soil around their households was not fertile. This proportion comprised of those households where it is literally impossible to grow anything in the backyard gardens without adding chemical fertilizers. 42% felt that the soil was moderately fertile while only 10% said that the soil was indeed fertile. It was found out that at almost all the households with backyard gardens, the crops grown were either onion or vegetables. This in the opinion of the researcher, suggested that people may have developed a culture of not rotating the crops that they grew and only concentrated on onion and vegetables. Lack of crop rotation leads to nutrient depletion and gradual loss of soil fertility.

The observed widespread land degradation at the open pit due to the excavations of huge pits in search of copper and cobalt ore, are also a problem because after the ore stocks are exhausted, the area will not be used for agricultural production, forestry or even human settlement due to the pits and the exposed bare rock surfaces. What was observed was in line with highlighted literature, (Owen; 1985) which stated that Open Pit Mining may quickly transform a scenic area of breathtaking beauty into an ugly wasteland.

## 6.5 NOISE POLLUTION AROUND NCHANGA TOWNSHIP

According to literature, (K.C.M.;2002), there is a lot of noise being produced by mining operations at N.O.P. It was discovered in the questionnaire survey that the majority of the respondents represented by 78% received noise from the open pit while only 22% said that they did not hear any noise. The people who *complained of getting noise from the Open Pit* where those whose houses were closer to the pit. Operations at the pit, according to management are carried out on a 24 hour basis and incidentally, a majority 48.7% of the people who complained of noise, said that they could hear it 24 hours a day. 30.8% could only hear the noise during the night. This noise is undesirable mainly because it disturbs people's rest thereby posing the risk of insomnia and can be deleterious to human health, in that it damages the cells of the corti of the inner ear and hence may result into noise deafness after a long period of years.

Unfortunately, there is little that can be done about the noise. If the mine has to remain open, the machinery has to continue operating on a 24 hours basis.

## 6.6 MEASURES BY THE MINE OWNERS

K.C.M. management has indeed put measures to mitigate and litigate the effects of mining on the environment within the mine as highlighted in the chapter on findings. It would be a bit too much to expect a sharp decrease in levels of pollution since the mining project at N.O.P is very big in that it produces 180,000 tonnes of copper/annum (Feeney; 2001) It has been appreciated that the impacts of open pit mining are not only confined to the mine itself but also spread to the surrounding residential areas. However, the litigation and mitigation measures have not concentrated on the surrounding residential areas. This is evidenced by the fact that 94% of respondents in the township, feel that K.C.M. is not doing anything to maintain environmental quality around their households. Only a meager 6% said that the company was constantly measuring ground water movement, watering down the gravel roads to reduce dust and attending to



community complaints through the safety, health, environment and quality department (S.H.E.Q).

Even though the residents of Nchanga township have bought the houses, K.C.M. still has a moral obligation to maintain environmental quality around households because the mining activities have a negative impact on the surrounding environment. The researcher also strongly felt that the people of Nchanga Township themselves, must change their attitude and take keen interest in maintaining good environmental quality around their houses. What came to light was that the majority of the respondents represented by 58% were not doing anything in order to contribute to a better environment. 30% where, however, adding manure and other organic matter to the soil around their houses in order to improve fertility, 6% were watering their yards to reduce on the levels of dust and a further 6% were boiling and chlorinating their drinking water.

## 6.7 STUDY CONSTRAINTS

Admittedly, it was not possible to produce a report that is 100% perfect due to the constraints outlined in chapter four, which may have led to errors. It was initially intended to take photographs of the observations incorporated in the findings, so as to provide a visual presentation. However, the researcher was met with hostility such that at first, even entering the mine premises was a very big problem. It was quite demoralizing but the study had to be done and therefore it was extremely important to persevere. It was after a long time of repeatedly asking for a gate pass that permission was granted to enter the mine premises. Permission to take photographs was not given.

Furthermore, Nchanga Township according to C.S.O-Chingola, has a total of 2,072 households. Ideally, a minimum of 10% of this sampling frame was supposed to be picked in the random sample. Unfortunately, this would have meant using a sample size of not less than 208 respondents. This was way beyond the researcher's financial and resource abilities.

Nonetheless, every effort was made by the researcher to ensure that these constraints did not hinder the successful completion of the study.

## **CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS**

### **7.1 INTRODUCTION**

This chapter presents the concluding remarks based on the findings. It also contains recommendations as well as suggested topics for further research.

### **7.2 CONCLUSION**

Open pit mining at N.O.P has a negative impact on the environment in Chingola. The dust that is released to the air lowers the air quality thereby increasing the prevalence of respiratory diseases such as coughs in the residents, especially those of Nchanga Township which is closest to the open pit. Furthermore, there is a reduction in water clarity owing to the fact that suspended solid particles resulting from carry-over of sediments with run-off from pit slopes find their way into the water consumed by the residents. This has also increased the prevalence of diarrheal diseases. Mining activities at Nchanga open pit also cause noise pollution which is a nuisance as it disturbs the residents of Nchanga Township. The lowered environmental quality has put people's health at risk and must thus be tackled with renewed vigour. Measures to address these negative impacts by K.C.M. are inadequate because there is no deliberate policy in use aimed at improving the environment around people's households in Nchanga Township. Furthermore, the residents themselves are also not interested in improving the quality of their won environment. This scenario is what is compounding the negative effects resulting from open pit mining. Thus, there is need for both K.C.M. and the government to involve local people in programmes deliberately created to improve the quality of the environment in Nchanga Township and Chingola as a whole.

The people's perception is that the reduction in air quality because of dust, the reduction of water clarity because of suspended solids, infertility of soil around their houses and the noise pollution is as a result of mining activities at N.O.P

There is need for Government policies regarding environmental protection to be strictly adhered to. Instead of the prevailing scenario where for instance mining companies such as K.C.M. are given long stability periods within which to comply with the country's environmental laws, G.R.Z must be seen to enforce these laws to a point where all the stakeholders polluting the environment comply fully with no delays. The environment must not be sacrificed for the sole purpose of obtaining monetary benefits from mining because this will in the long run deprive the current and future generations of a sustained livelihood.

### 7.3 RECOMMENDATIONS

- K.C.M. should start the process of back-filling or burying abandoned pits with over-burden material and restore the top soil organic matter content so that this land can in future be used for human settlement, recreation and agricultural use.
- G.R.Z., through the ministry of environment and natural resources, must embark on the planting of evergreen plants, grasses and epiphytes like orchids which have remarkable dust filtering, air cleaning and air purifying capacities.
- G.R.Z. through the Ministries of Lands and of Local Government and Housing must provide alternative land where the people who are living very close to the boundary between the mine and Nchanga township can be relocated.
- There must be a platform created where information on the maintenance of good environmental quality should be available to the local people. Radio and television programmes can be used to educate people about matters related to their environment. This will help them appreciate their environment more and hence see the need to participate in its maintenance.
- Residents of Nchanga township must develop a culture of practicing crop rotation in their backyard gardens. They should not just grow onion and vegetables but must also grow crops such as legumes and groundnuts which are known to replenish soil nitrogen. This improves fertility.

#### 7.4 FURTHER RESEARCH

Unlike in developed countries, In Zambia there is very little documentation of the effects of noise pollution on the health of living organisms such as human beings. It is not enough to base the country's knowledge of the effects of noise pollution on facts that have been documented in other countries because different types of noise produced by different sources have their own specific health effects.

It is thus cardinal to engage in further research, more especially on the Copperbelt Province around copper mines such as the Nchanga Open Pit, to find out the effects on the health of organisms such as man that noise produced by the various equipment and processes has

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Mining data

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APPENDIX (I)

AN INTERVIEW SCHEDULE TO FIND OUT PEOPLES PERCEPTION OF THE IMPACTS OF OPEN PIT MINNING ON THE ENVIROMENT IN 2004. (CHINGOLA).

Serial Number \_\_\_\_\_ Residence \_\_\_\_\_

Date \_\_\_\_\_

Dear respondent,

I am a fourth year student from the University of Zambia conducting research on the Environmental Impacts of Nchanga Open Pit Mine. You have been randomly chosen in a sample of respondents in this study. The information you will give will be kept confidential and for academic purposes only.

You will be directed on how to answer the questions

**SECTION A: BACKGROUND INFORMATION**

1. SEX (a) Male ☐ (b) Female ☐
2. How old are? \_\_\_\_\_
3. What is your level of education?

(A) None 

|  |
|--|
|  |
|  |
|  |
|  |

(B) Primary

(C) Secondary

(D) Tertiary
4. For how long have you lived in this area? \_\_\_\_\_

**SECTION B: AIR QUALITY**

5. How would you describe the levels of dust in the air around your home?

(A) No dust 

|  |
|--|
|  |
|  |
|  |

(B) Dusty

(C) Very dusty
6. Where do you think this dust comes from? \_\_\_\_\_  
\_\_\_\_\_
7. What is the reason for your answer in (6)?  
\_\_\_\_\_  
\_\_\_\_\_

8. Do members of your household suffer from respiratory diseases?  
(A) YES ☐ (B) NO ☐
9. If YES. What is the common respiratory disease that embers of your household suffer from?
- |                  |                      |
|------------------|----------------------|
| (A) Common cough | <input type="text"/> |
| (B) Bronchitis   | <input type="text"/> |
| (C) Tuberculosis | <input type="text"/> |
| (D) Asthma       | <input type="text"/> |
| (E) Emphysema    | <input type="text"/> |

**SECTION C: WATER QUALITY**

10. Are there any visible particles in your drinking water?  
(A)YES ☐ (B)NO ☐
11. Does your drinking water have any unusual taste? (Specify)\_\_\_\_\_
- \_\_\_\_\_
12. Do members of your household frequently suffer from diarrhea diseases?  
(A) YES ☐ (B) NO ☐
13. If YES. What do you think is the major cause of these diarrhea diseases?\_\_\_\_\_
- \_\_\_\_\_

**SECTION D: SOIL QUALITY**

14. How would you describe the fertility of soil around your house?
- |                        |                      |                          |
|------------------------|----------------------|--------------------------|
| (A) Very fertile       | <input type="text"/> | <input type="checkbox"/> |
| (B) Moderately fertile | <input type="text"/> |                          |
| (C) Not fertile        | <input type="text"/> |                          |
15. What crops are you able to grow around your house without applying fertilizer?\_\_\_\_\_
- \_\_\_\_\_
16. Do you think that the mining activities at the open-pit affect the soil fertility?  
(A) YES ☐ (B) NO ☐

**SECTION E: LEVELS OF NOISE**

17. Do you get a lot of noise from the open pit?  
(A) YES ☐ (B) NO ☐



18. What causes this noise? \_\_\_\_\_  
\_\_\_\_\_
19. At what time of the day is this noise loudest? \_\_\_\_\_
20. Do the walls of your house shake during blasting?  
(A) YES ☐ (B) NO ☐
21. Do the wall of your house have cracks?  
(A) YES ☐ (B) NO ☐

**SECTION F: MEASURES BY THE MINE OWNERS**

22. What is KCM doing to improve the quality of the environment around your house? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SECTION G. GENERAL INFORMATION**

23. What do you think should be done to improve the quality of the environment around your house? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
24. What are you doing in order to contribute to better environmental quality around your house? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
25. What else do you have to say over the general condition of the environment in this area? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## APPENDIX (II)

### THE UNIVERSITY OF ZAMBIA SCHOOL OF NATURAL SCIENCES DEPARTMENT OF GEOGRAPHY

#### DATA COLLECTION SHEET FOR NCHANGA OPEN PIT MINE

Dear Respondent,

I am a fourth year student from the University of Zambia conducting research on the Environmental Impacts of Nchanga Open Pit Mine. You have been selected on purpose to be a respondent. The information you will give will be kept confidential and for academic purposes only.

**Name of Organisation:** \_\_\_\_\_

**Position of Respondent:** \_\_\_\_\_

(1) When was Nchanga Open Pit commissioned? \_\_\_\_\_

(2) How many people are employed by this mine? \_\_\_\_\_

(3) How many are:  
(a) Skilled \_\_\_\_\_ (b) Semi-skilled \_\_\_\_\_ (c) Unskilled \_\_\_\_\_

(4) What Problems is the Open Pit Mine facing?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(5) Facilities at Nchanga Open Pit:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(6) What Minerals are mined?  
\_\_\_\_\_  
\_\_\_\_\_

(7) On average, how much tonnage of these is mined?  
\_\_\_\_\_  
\_\_\_\_\_

(8) Who are the major buyers of these Minerals?

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(9) What are the impacts of Open Pit Mining on the Environment?

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(10) What measures have you already put in place to minimize these impacts

(a) Within the mine? 

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(b) Outside the mine? 

---

(11) What are the planned notable improvements aimed at improving environmental quality.

(a) Within the mine? 

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(b) Outside the mine? 

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(12) What else can you say about the environment in relation to Open Pit mining at Nchanga? 

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**APPENDIX (III)**

**T-TEST USED TO COMPARE THE MEANS OF THE SOIL SAMPLES FROM NCHANGA NORTH AND NCHANGA SOUTH.**

**Hypotheses:**

**H<sub>0</sub>:** There is no significant difference between the means of the soil sample pH values from Nchanga North and Nchanga South.

**H<sub>1</sub>:** There is a significant difference between the means of the soil sample pH values from Nchanga North and Nchanga South.

**T-calculated is found using the following formula.**

$$T = \frac{|\bar{X}-\bar{Y}|}{S\sqrt{1/n + 1/m}}$$

Where  $\bar{X}$  is the mean of sample from Nchanga North=**6.19**

$\bar{Y}$  is the mean of sample from Nchanga South=**5.89**

S is the common standard deviation=**0.856**

With **n** and **m** representing the sample sizes of **7** and **9** respectively

And degree of freedom **n+m-2=14**

**T-calculated is thus=0.595**

**T-tabulated at 0.05 level of significance and 14 degrees of freedom=2.15**

**Conclusion:**

T-calculated is smaller than t-tabulated so H<sub>0</sub> is accepted, hence there is no significant difference between the means of the pH values in the samples from Nchanga North and Nchanga south.