Establishing a mining environmental monitoring and compliance mechanism for local authorities in Zambia: A case study of North-Western Province.

By:

Festus Mukuka Kakana

A dissertation submitted to the Department of Metallurgical Engineering in conformity with the requirements for the degree of Master of Science in Sustainable Mineral Resource Development

University of Zambia

Lusaka, Zambia

January 2020

Declaration

I Festus Mukuka Kakana declare that to the best of my knowledge and belief this dissertation (*establishing a mining environmental monitoring and compliance mechanism for local authorities in Zambia)* contains no material previously published by any other person except where due acknowledgement has been made. This dissertation contains no material that has been accepted for the award of any other degree or diploma in any other University.

Signed:……..…… Date……..

FESTUS MUKUKA KAKANA

Publications

Kakana, M. F., and Mutambo, V. (2019). '**Establishing a mining environmental monitoring and compliance mechanism for local authorities in Zambia: A case study of North Western Province**,' *2nd Zambia Conference on Mining, Metallurgy and Groundwater Resources*.

Kakana, M. F., and Mutambo, V. (2019). '**Establishing a mining environmental monitoring and compliance mechanism for local authorities in Zambia: A case study of North Western Province**,' the *ESDA-UNZA OPEN DAY MMR Publications*

Kakana, M. F., and Mutambo, V. (2019). '**Establishing an environmental audit tool for Local Authorities in Zambia to aid in environmental management**,' paper accepted to the 2020 *Engineering Institution of Zambia (EIZ) Symposium*, 17th – 18th April 2020, Avani Victoria Falls, Livingstone, Zambia and Life of Mine Conference 2020, 26th – 28th August 2020, Brisbane, Australia respectively but postponed due to convid19 outbreak.

Kakana, M. F., and Mwanaumo, M.E. (2019). '**Impact of value engineering in road construction on cost, quality and time management**,' paper submitted to the 2020 *Engineering Institution of Zambia* (EIZ)

Approved by:

The University of Zambia, School of Mines approves this Dissertation by FESTUS MUKUKA KAKANA titled Establishing a mining environmental monitoring and compliance mechanism for local authorities in Zambia: a case study of Northwestern Province in partial fulfillment of the requirements of a Masters of Science, degree in Sustainable Mineral Resource Development.

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Abstract

The mining industry is witnessing a momentous revolution due to a growing demand for metals, minerals and energy resources all over the world especially in the emerging economies of developed and developing countries. Mining in Zambia has played a key role in economic growth, social development and poverty alleviation but the supply of these resources has come with a lot of environmental and social costs. Most Environmental issues are cross cutting and requires integrated environmental management approach. In order to deal with environmental issues, Zambia has implemented adequate environmental legislation and signed international/regional agreements aimed at addressing environmental concerns. Despite such tremendous efforts, the implementation of these existing environmental regulations has not been satisfactory. Therefore, this study was undertaken in order to identify weaknesses and gaps in Zambia Environmental Management Agency's (ZEMA) Environmental Management Strategy through determining factors that have contributed to weaken monitoring of mining environmental issues by Local Authorities and formulating an Environmental Audit Tool (EAT) for effective environmental management.

A case study was carried out in North Western Province, in Kalumbila and Solwezi Districts respectively. The study utilized survey research through the use of interview guides, questionnaires and observations. A total of 40 questionnaires was purposively and conveniently sampled among participants depending on their responsibilities and knowledge held in environmental related subject and was administered with response rate of 80% and 84% from Solwezi and Kalumbila Council respectively. The primary data obtained from questionnaires was analyzed using Statistical Package for Social Science (SPSS) and Excel. A six-week internship conducted at ZEMA where guided interviews and observations were administered and utilized to establish an environmental audit tool.

Using a detailed literature review and questionnaires, the research reviewed that communication failure, administrative interference and lack of coordination, inadequate extension officers and technical capacity are the gaps and weaknesses in the ZEMA's environmental management strategy. Furthermore, lack of institutional capacity, engagement during license period and collaboration, administrative interference, insufficient knowledge in sustainable mining and

Corporate Social Responsibility are some of the factors that have hindered local authorities from monitoring mining environmental issues.

It can be concluded that mining environmental issues are cross cutting among a variety of sectors and hence the need for integrated environmental management approach. Engagement of local authorities in environmental management is one way of ensuring efficiency as creation of a safe and healthy environment starts locally.

Dedication

This dissertation is dedicated to my wife **Mrs. Esther P. H. Kakana,** thank you for loving me and being my Songs of Solomon. Because of you, I laugh, I smile and I dare to dream more than I ever have. Thank you for the miracle of you. You are, and always will be, the love of my life, my soul mate and my forever love. Thank you for the perpetual support and encouragement in good and hard times. I love you now and forever.

I also dedicate this dissertation to my princess baby girl **Lubuto Kayla Kakana**. You are a blessing, a gift from Heaven. Your mother and I prayed for you. You are our answered prayer. My precious little angel, I will always cherish and love you.

Further, I dedicate this study to my parents, **James S. Kakana** and **Scolastica T. Mukuka** for showing me the value of life and education, the importance of perseverance, for working so hard to make sure that I went to school and above all for impacting in me Christianity moral uprightness.

Acknowledgements

Almighty God

My special and most great thanks goes to the Almighty God my Heavenly Father who has given me this opportunity, sufficient grace and blessings to undertake this study.

Supervisor

I am highly grateful to my mentor Dr. Victor Mutambo for his invaluable and excellent motivation, moral and academic guidance to finalize this study.

Resource Organizations and Persons

I am grateful to Zambia Environmental Management Agency (ZEMA) for giving me an opportunity to do an internship and lean more on environmental management strategies within the agency. I also wish to thank Solwezi Municipal Council and Kalumbila Town Council management for the help rendered during collection of information. Special thanks also go to Shibuyunji Town Council management for allowing me to undertake this study.

Faculty and Research Staff

I am grateful to faculty members in particular Dr. Victor Mutambo, Dr. Bunda Besa, Dr. Jewette Masinja and Miss Longa Kabuswe for the endless effort rendered in helping me to be a successful graduate.

Family and Friends

I am very much thankful to my uncles, aunties, brothers, sisters, nephews and nieces for the full support rendered in completion of this project.

Lastly, but not the least, I am thankful to all my friends who always wished me success and helped me whenever I wanted them.

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Acronyms

Abbreviation	Description
AMD	Acid Mine Drainage
CSR	Corporate Social Responsibility
BI	Biannual Environmental Compliance Statutory Returns
DDCC	District Development Coordination Committee
EAT	Environmental Audit Tool
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EIAU	Environmental Impact Assessment Unit
EIAMS	Environmental Impact Assessment Management Strategy
EIS	Environmental Impact Statement
EM	Environmental Management
EMF	Environmental Management Frameworks
EMA	Environmental Management Act
EPB	Environmental Project Brief
EPPCA	Environmental Protection and Pollution Control Act
EMS	Environmental Management System
GDP	Gross Domestic Products
IEM	Integrated Environmental Management
IEMS	Integrated Environmental Management System
LA	Local Authorities
LAEAT	Local Government Environmental Audit Tool
MAC	Mining Association of Canada
NDP	National Decentralization Policy
NEMA	National Environmental Management Act
NGO's	Non-Governmental Organizations
NLTV	National Long Term Vision 2030
NWWSC	North Western Water and Sewerage Company
SD	Sustainable Development

SDG's	Sustainable Development Goals
SM	Sustainable Mining
SSPE	Strategic Social Partnership Engagement
SPSS	Statistical Package for Social Science
PTSU	Pesticide and Toxic Substance Unit
TSM	Towards Sustainable Mining
WANU	The Water, Air and Noise Unit
WDC	Ward Development Committee
WMU	Waste Management Unit
ZEMA	Zambia Environmental Management Agency

Chapter 1

Introduction

1.0 Background

Mining is a vital part of the Global economy. One of the most widespread management problems in the mining industry relates to the environmental effects that mining activities and processes have on the surrounding communities, humans and ecosystem due to air and water pollution, land degradation and subsequent sheer volume and chemical composition of waste material generated (IIED, 2002; Mudd, 2007). There is now, enormous recognition of the adverse impacts that mining has on social, economic and the environment.

Mineral resources are finite and therefore, require management that benefit the current and the future generation. In order to mitigate these environmental risks, there is need to implement an appropriate management and compliance scheme (Hudson-Edwards & Dold, 2015). Since environmental issues are cross cutting, different government departments mandated with environmental management and compliance must re-align their strategies and ensure that their policies, plans and programs have mainstreamed environmental issues in their operations.

In Zambia the impact of mining on the environment and surrounding communities has resulted from both previous and ongoing mining operations. These impacts are quite significant and often more severe, especially that Zambia does not yet have an adequate environmental management system of the sector. In an effort to enhance environmental wellness from mining environmental issues, Zambia has put in place legislations and signed international and regional agreements aimed at addressing environmental concerns, social - economic development and sustainable growth whose implementation has not been successful. It should be noted that environmental issues are cross cutting, therefore creating synergies for a clean and green environment and achieving sustainable development should start locally, hence the need for involvement of all key stakeholders in environmental management.

This study, therefore, aims to establish factors that hinder Local Authorities to monitor environmental aspects of mining as well as formulating an environmental audit tool that can be used to aid local authorities in environmental management, monitoring and compliance.

Further, the study identifies weaknesses and gaps in the Zambian environmental management, protection and conservation strategy, devising and implementing an appropriate response through an environmental audit tool that is more engaging (local authorities and communities) for monitoring results so as to safe guard human health and the environment.

1.1 Geographical Location

North-Western Province was used as a case study area particularly Solwezi and Kalumbila District as they are housing the three biggest copper mines in Zambia. Solwezi is the Provincial capital of North-Western Province. The growing mining town is located about 590 kilometres away from Lusaka, the Capital of Zambia. The district shares borders with Mushindamo and Kalumbila districts within North-Western Province. In the North, the district shares boundaries with the Democratic Republic of Congo (DRC). The district forms part of the Central African Plateau (IPT, 2018).

Kalumbila District is one of the eleven Districts of the North-Western Province. Kalumbila District borders with Solwezi District on the east, the Democratic Republic of Congo on the north, Mwinilunga District on the west, Kasempa and Mufumbwe Districts on the south. The District is approximately 120 kilometers away west of Solwezi Town. Figure 1.1 shows locations of Solwezi and Kalumbila districts.

Owing to Zambia's mining history, there are many mining previous site's that are still environmental nuisance. In the Copperbelt, more than 10,000 hectares are covered with mineral waste and that represent a "*loss of opportunity*" for local communities in terms of other land use such as agriculture, forestry, housing ranching etc. Kalumbila and Solwezi District being the new mining enclave has witnessed speed social-economic development since the establishment of the three biggest copper mines (Negi, 2016). To prevent further environmental nuisance occurring in North Western Province as experienced in the Copperbelt, Kalumbila and Solwezi Districts were purposely selected to establish a sustainable environmental management strategies through

identification of weakness and gaps in the current environment management approach and devise an appropriate action such as the Local Governmental Environmental Audit Tool (LGEAT).

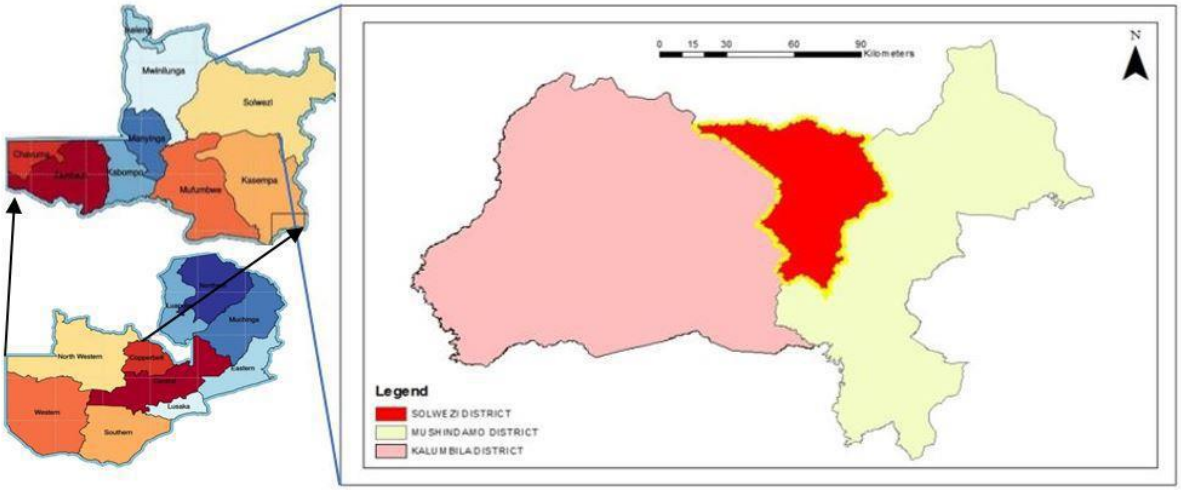

Figure 1.1: Location of Solwezi - red and Kalumbila - pink districts (IPT, 2018)

The districts falls in agro-ecological region III of the country. The average temperature rarely goes above 35 degrees centigrade; rainfall is above 1000 mm per annum and normally starting in October and ending in April (District-team, 2017).

1.1.1 Soils

Solwezi and Kalumbila districts have a greater diversity in their soil cover. The diversity creates a mosaic of different soils with corresponding fertility status. The soil ranges from fine red and orange clay loam and sandy loam soils derived from acid rocks to coarse loamy and fine loamy soils and coarse textured soils derived from Kalahari sands. The soils have low pH, low base parturition and clay mineralogy and low cation exchange. The torrential downpours of rains have scoured much of the land surface of Solwezi and Kalumbila carrying away much of the soil, causing gullies. The fertile ashes that are left after the winter veldt fires are also swept away. This activity has rendered vast tracts of land in the district unfertile. The Districts have some association of high potential soils in many parts (IPT, 2018).

1.1.2 Topography

Solwezi and Kalumbila district both lies in the higher portions of Central African Plateau. They are both 1400mm elevated with relatively sheer slopes, mountainous landscapes, gentle hills, anthills and dambo grass lands (Fulayi, 2016). The change in the districts geology of both districts to the south and north are characterized by high grounds and their topography and drainage are closely linked.

1.1.3 Vegetation

The major vegetation type is the Miombo wood land of the savannah formation, which has relatively undisturbed stands typically comprising of a 10 – 20 m high single storey, partly closed canopy of mostly pinnate leafed trees, a discontinuous under storey of broad leafed shrubs and an often spare but forbs, small sedges and Caespitose helophytic C4 grasses (Karen, El-Fahem, & Museteka, 2015). Most of the tree species have slender boles with initially sharply ascending branches which eventually spread out to support the light, shallow, often umbrella shaped canopy. The most dominant tree species only lose their leaves for a short period in the late dry season. In drier areas, the trees may seem to be completely deciduous while moist areas, the trees may be virtually evergreen. Generally, Solwezi and Kalumbila experiences a lot of rainfall and this supports a Miombo wood land that is evergreen associated with termitaria vegetation and bush groups of all types such as forest woodland thickets, shrubs and grasslands along the streams. The dominant species are Brachystegia, Isoberlinia angolensis, Marquesia macroura, Parinari curatellifolia species as in Figure 1.2.

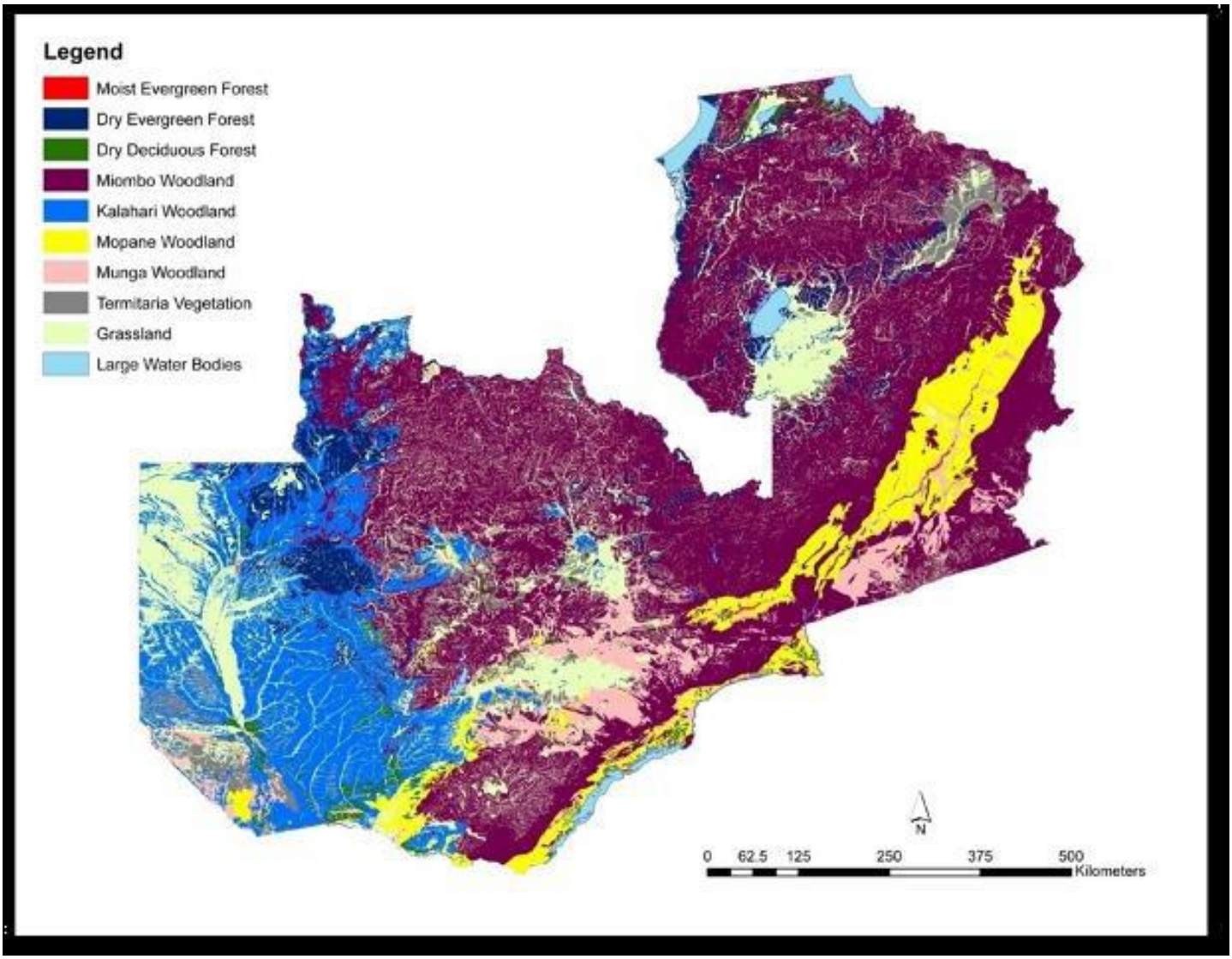

Figure 1.2: Zambia's vegetation cover (IPT, 2018)

1.1.4 Hydrological Characteristics

(i) Surface water

Surface water in Solwezi and Kalumbila comprises a series of major rivers and a lot of streams as shown in Figure 1.3. Some major rivers include; Solwezi river, Mutanda river, Mumbezhi river, Chifubwa river, Lunga river and Kabompo River.

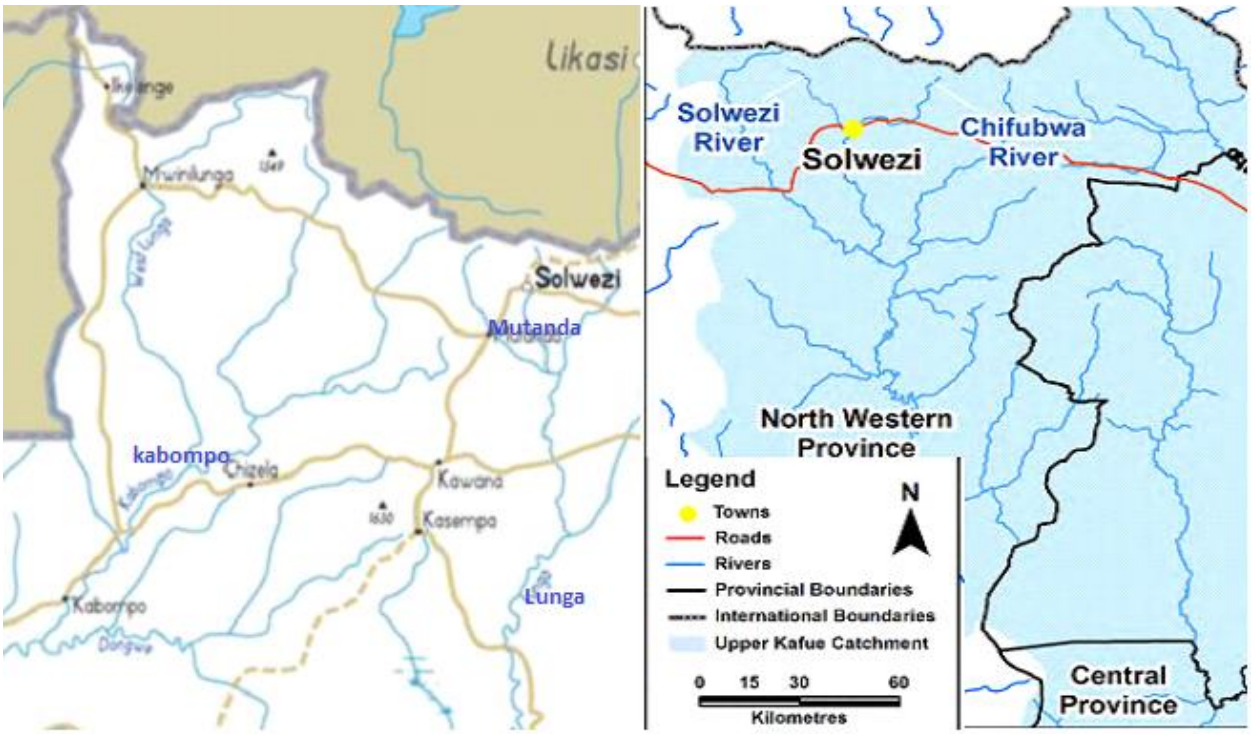

Figure 1.3: Rivers in North Western Province (www.rivers in North Western Province Zambia / image)

In Solwezi district, utilization of surface water is very low. The Solwezi River is used for domestic purposes and is collected and supplied by the North Western Water Sewerage Company (NWWSC) on commercial basis. The river system has a great potential for agriculture and other industrial activities. In rural areas it is used mostly for domestic purpose.

The main river system in Kalumbila district is the Kabompo River on the west where the Zambezi-river-basin lies and is the boundary for the two districts (Mwinilunga & Kalumbila). There are many rivers, rapids and small waterfalls in Kalumbila. Notably are the rapids at Mutanda River and Mumbezhi River. The quality of surface water has not been fully investigated. However a few tests done downstream on Mumbezhi River (in Lumwana east), indicated the presence of iron. This is because water resources pass near human settlements. Utilization of surface water is very low; the surrounding villages use surface water from rivers and shallow wells for domestic purposes. The river system has a great potential for agriculture and other industrial activities. In short, it is underutilized and in rural areas it is used mostly for domestic purposes.

(ii) Ground Water

Hydro-geologically, the districts are overlain by the Katanga undifferentiated Kandelungu lithographical units. The resulting aquifer of this geological formation is characterized by the following:

1. Lithology comprising of mainly shale over an area of 18, 323 square Kilometers;
2. Ground water storage of 1.9 x109 cubic meters per year;
3. Ground water level yield at an average of 1.5 liters per second; and
4. Ground water level fluctuation of 2.55 meters per year.

The ground water (GW) is the most widely but, not extensively used water resource. The water obtained from the GW resources is used mainly for domestic purpose. There are no reported cases of poor quality of borehole water. The water wells tend to vary in quality because they are close to settlements and are open and widely used.

1.2 The Problem Statement

Zambia being endowed with a wealth of natural resources has largely been a mining country. These resources which include copper, lime, gold and coal among others, have been used as industrial materials in technological advancement, infrastructure development and food and energy production. In Zambia, mining has played a key role in economic growth, social development and poverty alleviation but the supply of these resources has come with a lot of environmental and social costs. Poor mining practices and mineral processing has continued to pollute the air, land, water thereby spoiling the environment. These environmental effects have continued long after mining operations have stopped. In order to enhance environmental management, monitoring and compliance, Zambia has put in place adequate environmental regulations whose implementation has not been successful.

Though extensive research has been done regarding mining environmental management strategies in Zambia, no study has been undertaken to establish factors that have led to weak monitoring of mining environmental issues by Local Authorities as mandated by the Local Government Act No. 2 of 2019 so as to maintain a productive healthy environment. Most studies (Banda, 2016; Chifungula, 2014; Jeswiet, 2017; Lindahl, 2014; Masinja, 2015 & Simutanyi, 2008) have focused on impacts of mining on the environment, sustainable mine waste management approaches and have not been extended to the contribution that Local Authorities can make in mine areas to safe guard human health and the environment as well as support the adequate existing Zambian laws and regulations regarding environmental management and protection.

This study, therefore, aims to establish factors that hinder Local Authorities from monitoring mining environmental issues and formulate an environmental audit tool that can be used to aid local authorities to establish and maintain environmental health services. Further, the study also identifies areas of weakness and gaps in the Zambian environmental management and conservation strategy to help plan and implement an appropriate response (An Environmental Audit Tool) that is more engaging (local authorities and communities) for monitoring results and learning to ensure progress in mineral development. Since environmental issues are cross cutting, an audit tool is aimed at providing a platform for Local Authorities to work with ZEMA, government institutions and other stakeholders to champion environmental stewardship and facilitate institutional capacity

for relevant Local Authorities and the community in environmental management to safe guard human health and the environment.

1.3 Aim of the study

1. To identify areas of weakness and gaps in ZEMA's environmental management strategies.
2. To devise an appropriate environmental management and compliance strategy through engagement of local stakeholders.

1.4 Study Objectives

1. To determine factors that have contributed to weak monitoring of mining environmental issues by Local Authorities.
2. To design an environmental audit tool that could be adopted by Local Authorities to aid in environmental management and compliance.

1.5 Research Questions

1. What factors have affected local authorities from monitoring mining environmental issues?
2. To what extent can local authorities contribute to mining environmental management and compliance?

1.6 Methodology

i. **Objective 1:** Information about factors that have led to weak monitoring of mining environmental issues was obtained from literature reviewed, Zambian regulations and policies on environmental management combined with information analysis from questionnaires. Questionnaires were purposively and conveniently sampled among 40 (forty) participants (20 Council Officers, 10 Councilors and 10 Ward Development Committee (WDC) Executive Representatives). The 40 Questionnaires were divided into two halves between Solwezi and Kalumbila Council respectively. The 10 council officers responsible for environmental related activities from Solwezi and Kalumbila Councils

represented 80% of the Public Health Services Department and 95% Planning Department respectively. Five (5) of each councilors and community executive representatives from each council represented 100% and 50% councilors from Solwezi and Kalumbila respectively and 63% representation of community executive representatives from each council. All representatives were purposely and conveniently sampled because of their responsibility and the type of information they held which was necessary for the study. Information obtained through the questionnaires included; benefits of mining, environmental impacts of mining, established mining environmental mitigation measures put in place in Solwezi and Kalumbila Districts and finally factors that hinder local authorities from monitoring mining environmental issues. The information was obtained by distributing questionnaires coupled with interviews to the identified participants. The information was analyzed using SPSS into a presenTable form to deduce factors that have hindered institutional capacities to monitor mining environmental issues. Recommendation was given which formed part of the information for formulation of an audit tool.

ii. **Objective 2:** Information to design an environmental Audit Tool was obtained from Zambia Environmental Management Agency (ZEMA), an institution tasked to provide for ***integrated*** environmental protection and conservation and sustainable management and use of natural resources. ZEMA was purposely chosen to perform a benchmark study regarding environmental management and compliance. Information was obtained through a six (6) weeks internship aimed at understanding the current mining environmental management strategies used in Zambia. Information was acquired from the Environmental Impacts Assessment (EIAU) Unit on how to systematically identify, predict and evaluate potential positive and negative impacts that a proposed project may have on the environment in its totality that is physical, biological and social-economic aspect and how to conduct an environmental verification exercise. Information gotten from Water, Air and Noise (WANU) and Waste Management (WMU) Units was biased towards water, air and noise pollution control and sustainable handling of waste and how to prepare water, air, noise and waste disposal licence conditions respectively depending on the developments and environmental impacts. Data collected from Pesticide and Toxic Substance Unit (PTSU) was concerned with handling of chemicals through identification of their specific

hazards and subsequent communication of this information to end users. Info was acquired through 10 days active departmental participation attachment each to EIAU and WANU respectively and 9 days attachment each to WMU and PTSU respectively. Finally, information was logically and technically compiled to design an environmental audit tool that can aid Local Authorities in monitoring future mining environmental issues.

1.7 Significance of the Study

This study is important as it will strengthen Zambia's legislations and policies on mining environmental monitoring and compliance through engagement of local authorities and communities. According to Vision 2030, it will also contribute to human development through creation of a safe and healthy environment by helping to attain some of the sustainable development goals (SDG's) including Goal No. 3, 6, 14, 15 and 17 shown in Figure 1.4. Further, the study will add to the body of knowledge in environmental management and compliance strategy that support integration of local authority and community in safe guarding human health and the environment through the use of an environmental audit tool.

Figure 1.4: Sustainable Development Goals (www.sdg.com)

1.8 Scope of the study

The study is concerned with establishing factors that hinder local authorities to monitor mining environmental issues and create an environmental audit tool for monitoring future mining operations in Zambia to enhance environmental compliance so as to safe guard human health and the environment. The study is limited to local authorities that are housing mines in their respective districts. Kalumbila and Solwezi districts of North Western Province have been identified to be case study areas as they are currently housing three biggest mining industries in Zambia and are most affected by their operations.

Mining has many environmental issues but this study will also be limited to environmental impacts with mostly local and regional effects and those that have direct or indirect impacts on Local Authorities service provisions. Environmental impact at the global scale such as emission of greenhouse gases will not be considered but limited to; air pollution, soil contamination, water pollution and siltation and land degradation.

1.9 Dissertation Structure

The outline of this dissertation is as follows:

Chapter 1 serves as an introduction which gives the background to this research study. It details the research problem statement, objectives, arising research questions and methodology. Further, it elaborates the major significance of the study. Finally, the Chapter is concluded by highlighting the justification, scope of the research and reviewing the study geographical profile.

Chapter 2 reviews literature on the global perspective of mining giving its merits and demerits and the need for sustainable mining so as to safeguard human health and the environment. It highlights different Environmental Management Strategies (EMS) that were adopted globally as guiding principles advocating for sustainable global change to lessen environmental degradation which came as a result of unsustainable human activities. The Chapter further discusses diverse EMS adopted by different nations including South Africa as it embarks on relating them to the study objectives. The chapter also looks at the environmental management overview in Zambia. This Section is intended to provide environmental management strategies used in Zambia to

mitigate environmental issues that have local effects. The Section begins by reviewing the Zambia Environmental Management Agency strategies in water and air pollution control, waste, pesticide and toxic substances management. Additionally, it looks at the Environmental Impact Assessment to garner a broad understanding of Zambian Environmental Management system so as to understand gaps and weakness needed to devise an appropriate environmental management mechanism. The Section ends by reviewing Zambia's relevant environmental regulations necessary in Zambia. Furthermore, it reviews mining in Zambia and the need for Integrated Environmental Management System (IEMS) as supported by Zambia's developmental agenda which advocates for inclusiveness without leaving anyone behind. This provides the basis for evaluating global environmental management strategies to deduce the most suiTable and sustainable approach through formulation of an Environmental Audit Tool (EAT) to enhance environmental and human health which is the second objective.

Chapter 3 discusses detailed methodology that were undertaken by the researcher to explore the objectives of the study which include: to determine factors that has contributed to weak monitoring of mining environmental issues by Local Authorities and to design an environmental audit tool that could be adapted by Local Authorities to aid in environmental management and compliance to safeguard human health and the environment. The study adopted the Mixed Method (MM) because of its ability to alleviate the weaknesses and provide richness and details. The use of a Mixed Method approach was rooted in both philosophical and practical reasons, which are explained in detail to justify the Mixed Method approach for this thesis. The Chapter consists of the following Sections: study location, the research design, research approach and the Delphi method.

Chapter 4 is solely devoted to presenting, analyzing and discussing the raw data of the research. It presents the research findings and answers questions posed in Chapter 1. The genesis of this Chapter is focused on the findings from ZEMA. This sets out the benchmark for the study on Zambia's environmental management strategies. This is then preceded by an elaboration on the weaknesses and gaps in the Zambian environmental management systems against their mitigation measures and finally establishment of the Environmental Audit Tool (EAT). The EAT is framework for Local Authorities (LA) to safeguard human health and the Environment within their

jurisdiction. Lastly, the Chapter ends with establishing factors that have led to weak monitoring of mining environmental issues by LA with their recommendations.

Chapter 5 will garner on the findings of this dissertation and highlights the contribution of LA to the field of mining environmental management and monitoring strategy particularly focusing on achieving sustainable mining in Zambia. Results will be accordingly summarized and concluded with suggested recommendations. Some areas that will require further research will also be identified.

Chapter 2

Literature Review

2.0 Introduction

Mining is part of everything we do and everything we touch. Mining products are used in infrastructure and housing development, energy production, technological advancement and food production. Mining contributes more than 45% of the world's measured economic activity and considering the seven billion world's population and its expected increase by 700 million by 2020 and the 3% economic growth, the appetite for raw materials to build infrastructure, generate energy, create products and produce food will also grow. Mining is a vital part of the global economy, but the extraction of metals, metalloids, and other mineral products generates vast quantities of liquid and solid waste (Hudson-Edwards & Dold, 2015). One of the most widespread management problems in the mining industry relates to the sheer volume and chemical composition of waste material handled (IIED, 2002). Decrease in mining activities has direct and indirect effect on the social-economy development and less destructive on the environment. This can be commended to be a good thing but because of the demand for mining products, mining will grow again unless we achieve 100% recycling (Jeswiet, 2017). Of all the human endeavours, mining has been identified to move more earth than any other yet mining industries claim to practice sustainable mining (SM). Sustainable mining has been defined as a link between social-economic developments to environmental wellness (American, 2018). Statistics shows that mines consume 10% of world's energy, responsible for 13% sulphur dioxide emissions and threatens almost 40% of world's undeveloped forest while accounting for 0.5% employment and 0.9 Gross Domestic Products (GDP) (Kirsch, 2010; Masinja, 2015 and Whitmore 2006).

According to Mudd (2017), the issue of waste management is correctly perceived to be a major issue for local authorities, the manufacturing, construction and chemicals industries. However, collaboration in environmental management and compliance especially on mining environmental issues that have direct or indirect impacts on the local authorities service provision such as health, sanitation, rural and urban planning and agriculture related activities should be recommended so

as to safeguard human health and the environment. Environmental wellness is one of the key pillar of sustainable development (SD) and Zambia been one of the African countries committed to attain Sustainable Development Goals (SDG's) according to the Vision 2030 should put in place effective environmental management strategies. How has sustainable development contributed to creating a health and safe environment and what strategies have countries put in place to safeguard human health and the environment?

History on sustainable development entails that it was not until the late 1980s, when the term sustainable development began to gain global acceptance when it first appeared in *Our Common Future*, also known as The Brundtland Report. The result of UN-convened commission created to propose a global agenda for change in the concept and practices of development, the Brundtland report designated on considering how human activities were done and governed (Strange & Bayley, 2008). To find an effective way of meeting human needs and aspirations would require new approach of considering old problems as well as working together not only locally but at international level as well (CISL, 2017). This report came as a result of continued environment degradation due to human activates hence it emphasised on re-thinking our ways of doing things in all areas of human activities (Dubiński, 2013). Figure 2.1 gives the summary of the purpose and outcomes of the UN-convened commission. How can Zambia sustainably manage its environment? Can engagement of local authorities in monitoring of mining environmental issues enhance environmental management and compliance? How can this be achieved?

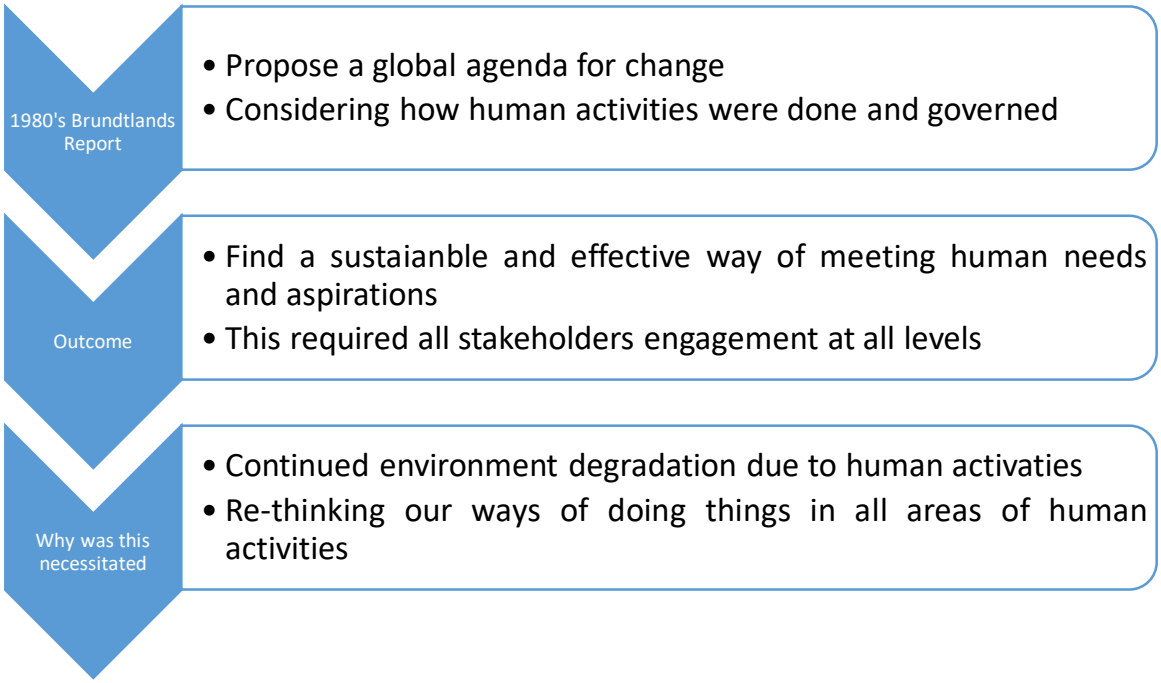

Figure 2.1: Graphical Summary of UN-convened commission outcome

Further down the history on the implementation of sustainable development, the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 (the so-called "Earth Summit") highlights how different nations come together and delivered a pronouncement of principles, core values, a detailed Agenda 21 of anticipated actions, international treaties on climate change and biodiversity, and a statement of principles on forests (Kates, Parris, & Leiserowitz, 2016). "In the wake of the Rio Conference of 1992 and the following international adoption of Agenda 21, Article 24 of the UNCED Constitution guarantees the right of everyone to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development" (Hattingh, 2001). History has so far shown the importance of stakeholder's engagement and an integrated kind of environmental management in creating a safe and harmless environment through international collaboration which trickles down to communities at local level. This has been supported by the proceedings of the 62nd Annual Conference of the Local Government Association of Zambia which stated that sustainable

development starts locally. In 2002, at the World Summit on Sustainable Development in Johannesburg, South Africa, the commitment to sustainable development was reaffirmed. Because of the efforts stated above, today, sustainable development has spread rapidly and is now dominant to the mission of both developed and developing countries all over the world as summarized in Figure 2.2.

Figure 2.2: Graphical summary of the United National Conference on Environment and Development (UNCED) and the World Summit on Sustainable Development

Sustainable mining is one key area that contributes to sustainable development through efforts in mitigating environmental impacts, protecting human rights, promoting social inclusion and enhanced mining benefits (Environment, 2018). Finding shows that one of the challenges of sustainable mining is to establish a technology for extracting mineral resources which will eliminate and minimise the negative effects of mining processes as well as develop a technology to repair the effects of mining so as to restore the lands used for further reuse (Kates, Parris, & Leiserowitz, 2016). What other environmental management and compliance strategies has been adopted by different nations to safeguard human health and ensure conservation and protection of the environment and sustainable use of mineral resources?

Different environmental management strategies have been implemented in different nations aimed at mitigating mining environmental impacts and safeguard human health and the environment. Both in the Poland and world mining sectors, various technologies have been developed and implemented for the reclamation of post-mining areas. Cities like Portland have recognised sustainable principles at constitutional level and are defined in the Environmental Protection Act (Dubiński, 2013).

Other countries such as Canada together with the Mining Association of Canada have adopted the Towards Sustainable Mining (TSM) guiding principles for its mines to ensure sustainable environmental management and compliance as affirmed by Jeswiet (2017). The Mining Association of Canada (MAC) uses the TSM guiding principles for its members to provide a checklist or as an audit tool to mitigate environmental impacts. Stakeholder's involvement is the first principle in the Towards Sustainable Mining. It's a concept that promotes an inclusive pathway in environmental management without leaving any one behind. Introduction of an environmental audit tool for local authorities in Zambia's environmental management system can also help create platform for continuous environmental monitoring to ensure compliance so as to safe guard human health and the environment. TSM Details are shown in Appendix 3.

The concepts of TSM have been supported by many other scholars including; (Ahmad et al, 2005; KIN, 2012, Lopatta, Jeaschke,Chen, 2017) states that stakeholders engagement is key to creating a more "meaningful existence and sustainable planet". Local authorities in mine fetched areas, mining companies, the communities, private sectors that depend on each other for survival, must work together to help create a prosperity and eliminate poverty in the context of a liveable and inherently sustainable planet. Stakeholders engagement moves us from the insular current state of mining to a more innovative and collaborative future. Additionally Laurence (2011), has outlined five important areas that must be addressed in sustainable mining including: Environment, Economic development, Community engagement, Safety and Resource Efficiency. Further, Kirsch (2010) has reaffirmed once more on Stakeholders engagement stating that communities should be continually told about the companies plan as well as inviting them to modify them. Public engagement/participation should not just be a once off activities but continuous as it is key element in environmental management and development decision making in sustainable governance (Meadowcroft, 2004). Furthermore (LGAZ, 2018; Statement, 2015) has

affirmed that creating synergies for a clean and green environment starts locally through community participation.

England is another country that supports community engagement. England, being the decorous status as the centre for mining companies, mining financing and its industry-sponsored initiative of sustainable mining, is where this concept of Mining and Communities started from. These initiatives have been aimed at addressing the following mining myths which includes; the supposed need for more and more minerals from the ever and more mines, the claim that mining catalyses development, the belief that technical fixes can solve almost every problem and the inference that those opposed to mining mainly comprise of ignorant and anti-development communities and NGO's (Whitmore, 2006). The last myth entails that communities must be well vested in mining operations from inception to post closure so as to restore the land used for future reuse. What environmental management community engagement is being implemented in Africa?

In South Africa all mineral rights are held by its government, and allocated on a "use it or lose it" principle. A prospecting right is allocated for a period of 5 years. Despite the mining industrys' positive contribution to its economy and protected by historical precedent and legislation, communities affected by mineralized pollution have set up community activists and crisis committees to challenge mining environmental issues. Regardless of their initiative, communities have struggled to challenge companies and government to regulate mining activities because mining companies have shown good places, and hide the bad. They have further bought off, government officers and influence community leaders in kind to support their unsustainable mining practices. According to the University of Pretoria (2014), understanding the consequences of unsustainable mining, community activist and other key stakeholders have been consulted by the developer on the growing environmental consequences of unsustainable mining and their mitigation measures on their surrounding community as well as encouraging public participation as provided for in Chapter IV, Section 10 of the Mineral and Petroleum Resources Development Act 28 of 2002, the National Environmental Management Act (NEMA) and the international Environmental Law (Oosthuizen, 2014). Environmental management strategies employed include organizing, monitoring, participation in processes including EIAs, lobbying government officials, and parliament, and working with the media. The aim of community activist is to let all key stakeholders understand the risks of unsustainable mining so as to stop the tide. The other approach

involved formulation of crisis committee in mining areas to monitor mining environmental issues (Munnik, Hochmann, Hlabane, & Law, 2010).

Further, South Africa has adopted the Environmental Impact Assessment and Management Strategy (EIAMS) which has outlined a set of 4 principles including: principles of Public Participation, Reasonableness and Administrative Discretion, Sustainability and Integration (as shown in Appendix 6 – principle of integration) in order to achieve an environment that enhances human health and well-being, and to ensure that the environment is protected for the benefit of present and future generations. The EIAMS entails the implementation, adaptation and/or reformulation of the Integrated Environmental Management (IEM) system currently being implemented by the National Environmental Management Act (NEMA), in order to integrate effectively environmental considerations into all aspects of governance including Local Authorities (Oosthuizen, 2014). This replaces the Environmental Management Frameworks (EMFs) which have been utilized since 2008 as a strategic environmental instrument to provide a strategic context for project level decision making and the processes involved in the issuing of environmental authorisations. The EIAMS aims to provide a more effective and efficient IEM system that is supported by a range of EM instruments and tools such as the Gauteng Conservation Plan Version 3, South Africa's National Biodiversity Strategy and Action Plan 2015 – 2025 among others (Compaan, 2011).

If South Africa has been able to achieve such using community activism, how much more can Zambia achieve using legally established Ward Development Communities as outlined under the Local Government Act? The Integrated Environmental Management can be compared to the Environmental Audit Tool that support Local Authorities to take a prior active role in integrated environmental management in Zambian through continuous monitoring, participation in processes including EIAs, lobbying government officials, NGO's and parliament, and working with the ZEMA to ensure sustainable use of natural resources and protection of the environment to safeguard human health and the environment.

Zambia being endowed with a wealth of natural resources has largely been a mining country. Almost all the districts in Zambia have an active mine or an application for possible mining as shown in Figure 2.3. In an effort to enhance environmental wellness from impacts of active and historic mining activities, Zambia is a member of a number of international and regional agreements organisations aimed at addressing environmental concerns. An organisation such as the United Nations Framework Convention on Climate Change requires parties to take practical steps in limiting activities which have potential to accelerate climate change. In February 2009, Zambia and other African Union members formally adopted The African Mining Vision. The vision advocates for transparency, equiTable and optimal exploitation of mineral resources to underpin inclusiveness, sustainable mineral-based structural transformation and socio-economic development.

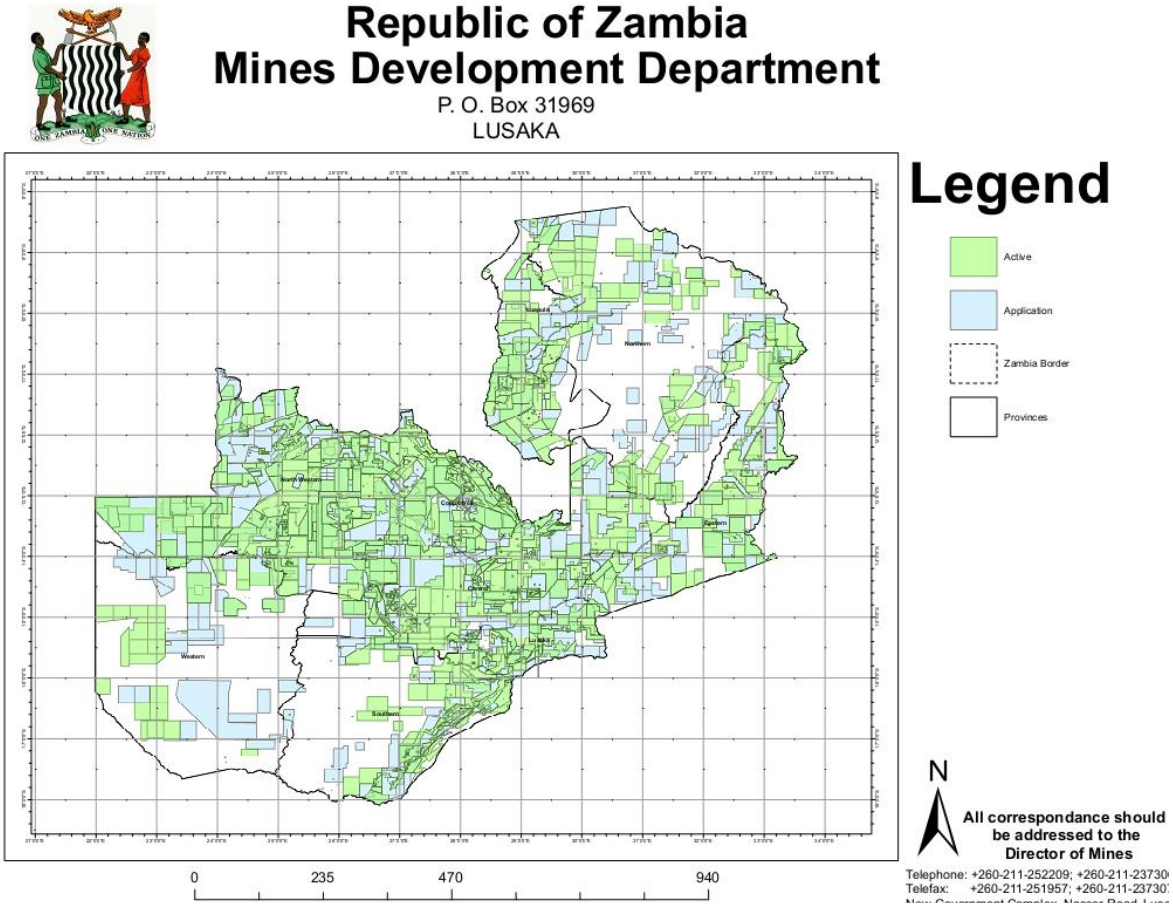

Figure 2.3: Zambian map showing active mines and applications for possible mining (Mine Development Department)

To ensure a successful implementation of The African Mining Vision, The African Minerals Governance Frameworks was designed as a monitoring tool to help African countries track its implementation process (ECA, 2018; Masinja, 2015). The frameworks objectives includes; better ways of measuring mineral economics and governance capacity in its African members, establishing gaps and serve as a tool to assist government to bridge these gaps, responds to challenges faced in implementing the vision as well as supporting innovative and comprehensive approaches to accelerate successful implementation of the African Mining Vision. One of the six thematic pillars of the African Mineral Governance Framework is centered on Environmental and Social Issues which is aimed at improved and sustainable quality of life for mining-affected communities and the country as a whole through strengthening of the environmental, social, economic and cultural protection policies, laws, systems and capacities of communities to benefit from mineral exploitation (ECA, 2018).

The impacts of mining operations in most Zambian communities results from both historical and ongoing mining operations. These impacts are quite significant and often more severe, especially the fact that Zambia does not yet have an adequate management system of the sector (Banda, 2016; Chifungula, 2014; Lindahl, 2014). These impacts have mostly been associated on the Copperbelt Province but with the recent investments in exploration and mine developments have, however, led to new operations also in other provinces such as North-Western Province. This study will focus on environmental impacts with mostly local and regional effect which includes air pollution, soil contamination, water pollution and saltation and land degradation and have direct or indirect impacts on Local Authorities services provisions.

2.1 Environmental Impacts from Historic Mining Activities

Owing to Zambia's mining history, there are many mining history site's that are still an environmental nuisance. However, because of historic site mining potential, there are now mining operations that makes it hard to distinguish between historical and current impacts of mining for example the Maamba Collieries Limited. Generally, the environmental issues associated with historical mining are largely related to geotechnical integrity of waste dumps and pits (Banda, 2016). On the Copperbelt, more than 10,000 hectares are covered with mineral waste and that represent a "*loss of opportunity"* for local communities in terms of other land use such as

agriculture, forestry, housing, ranching etc. other hazards include the use of tailing dams for water supply and fishing as well as growing crops which pose a great threat to human health.

The issue of Acid Mine Drainage (AMD) caused by sulphide minerals in the waste damps and pits when exposed to oxygen and water cannot be overemphasized (Azam S. , 2008). The results will be low pH waters with high metal content. If this water finds its way into ground or surface water bodies, they result into water pollutions and are a threat to biodiversity and human health. However, an extensive study shows that the environmental problems contribution from old mining legacy sites is only minor compared to active mining operations (Banda, 2016).

2.2 Environmental Impacts of Active Mining Operations

Since 2001, privatizations has seen most state owned and unprofiTable copper mines been revived through extensive investments by new owners. Because of the high investment capital and in an effort to make profit on the investment made through scaling up production, mining operations have overlooked most important environmental concerns. These local and regional serious environmental impacts directly linked to active mining operations are described here.

2.2.1 Air Pollution

Zambia's mining industries mostly smelters contributes over 98% of countries SO_2 emissions. By 2000's, an estimate of 346, 700 ton/year SO_2 emissions was established (Banda, 2016). ZEMA has predicted a rise in SO_2 emissions because of investment in new copper smelters. High concentration of SO_2 is hazardous to human health, biodiversity and plant. Oxides of Sulphur and Nitrogen can cause respiratory irritation, aggravated asthma, emphysema and bronchitis. It also contributes to acid rains which pose a threat to aquatic life, human and plants.

2.2.2 Soil Contamination

Soil contamination occurs when high concentration of metal particles from dry tailing dams and smelters are wind-borne/particle fall out. These metals constitute significant hazards to human

health, land degradation and make the soils unproductive in terms of agriculture. Studies show that soil contamination are mostly in historic mine towns (Hudson-Edwards & Dold, 2015).

2.2.3 Water Pollution and Saltation

The mining operations within or near the catchment of water bodies are under increasing threat of pollution as well as competition in water utilisation. This is due to the nature of many mineral deposits now being processed which contain sulfidic minerals. When exposed to fluctuating cycles of water infiltration and oxygen (i.e. air), the sulfides oxidize and cause acid and/or metalliferous drainage. The high concentrations of potentially toxic elements in these wastes can pose risks to ecosystems and humans as aquatic biology is more sensitive to contamination than higher animals and plants and therefore, water quality for standards with the aim to protect aquatic life are often considerably stricter than standards for drinking water (Banda, 2016; Hudson-Edwards & Dold, 2015). In Zambia, cities supplied by Kafue River and its brunches have mostly being affected because of the mining history on the Copperbelt and its water use downstream in irrigation, domestic and fishing purposes.

Kalumbila and Solwezi District of North Western Province being the new mining enclave has witnessed speed social-economic development since the establishment of the three biggest copper mines (Negi, 2016). Based on sustainable mining as practiced in Zambia according to (Harmon, 2017; Mines, 2017) and despite assurance of less air pollution in North-Western Province because of the technology employed by the mining houses, there is still potential for air and water pollution, land degradation, water consumption and unsustainable waste disposal (Lindahl, 2014). These mining wastes have had adverse environmental impacts directly or indirectly on the services provided by Local Authorities in mine housing districts.

Additionally, a few observations indicates that there will be less air pollution from the emissions of both SO_x , NO_x and PM_{10} from new smelters due to new technology implemented but Whitmore (2006), has argued outlining how history shows that the use of technology has been prohibitive because of economies associated with it and has not fully covered all areas of mining. To some extent it has just benefited the extractive industry and not necessarily the environment and local communities. The dust fall-out from dry tailings is likely to be the same as described for the

Copperbelt, and the long term potential for soil contamination is unsecure. Regarding pollution of surface water in the North Western province there are concerns for two reasons. Firstly, the potential for acid mine drainage formation is more likely to occur due to less favourable geological conditions. Secondly, the bedrock naturally contains rather high concentrations of uranium. The run-off from the relatively new mining areas is towards tributaries of both the Upper Kafue and the Upper Zambezi River which are the major source of domestic and commercial water use, where the latter one is less supervised (Lindahl, 2014). How then, can LA be integrated in mining environmental monitoring and compliance system?

2.3 Environmental Management Overview in Zambia

The general legislative framework for environment issues in Zambia is in many ways quite similar to other developing and developed countries. Zambia Environmental Management Agency (ZEMA) formerly Environmental Council of Zambia (ECZ) has the mandate to do all such things as are necessary to ensure the sustainable management of natural resources and protection and control of pollution. Environmental issues cut across a variety of sectors and a number of government institutions are involved in environmental management issues. There is, however, a lack of coordination between ZEMA and other institutions and as a result, the implementation of existing environmental regulations has not been satisfactory (Lindahl, 2014). Following an enactment of the Environmental Protection and Pollution Control Act (EPPCA) CAP 204 of the Laws of Zambia in 1992, the Agency was created. In 2011, the Environmental Management Act (EMA) No. 12 of 2011 repealed the EPPCA.

This Section shows some of the legislation that support local authorities as conservancy authority and the need for ZEMA to implement an integrated environmental management approach.

2.3.1 ZEMA's Environmental Management Strategy

The EMA provides for the continued focus on Environmental Management with an inclusion of new and emerging issues such as climate change, pollution from Persistent Organic Pollutants and electronic waste. The following are the legal provisions in EMA which ZEMA uses to safeguard human health and the environment.

1. Part IV of EMA No. 12 of 2011 prohibits pollution of water and provides for the licensing mechanism for mining, industries and institutions discharging wastewater into the aquatic environment as described in Section 2.2.1 under environmental impact assessment. It prohibits wilful or negligent pollution of water and also makes it an offence for anyone who fails to prevent or report water pollution.

2. Section 45 of EMA provides for the control of air pollution and prohibits discharge into the environment, provide for the licensing of emissions of pollutants or contaminants into the environment.

3. The EMA No. 12 of 2011 provides for the prosecution of anyone found indiscriminately disposing off waste, illegally collecting, transporting, sorting, recovering, treating, storing, or otherwise managing waste in a manner that results in an adverse effect on human, animal or plant life. Its therefore provides for licensing of waste management.

4. Section 112 (1) and (2) of the EMA No. 12 of 2011 provides for the offences related to pesticides and toxic substances as well as provide for their licensing conditions.

5. The EMA No. 12 of 2011 under Section 67 prohibits noise pollution which is produced by mining, construction sites, plants, machinery, motor vehicles, aircraft, including sonic booms and industrial and commercial activities. In consultation with other relevant appropriate authorities, ZEMA applies appropriate measures to ensure the control of the noise.

2.3.2 Environmental Impact Assessment

The Environmental Impact Assessment (EIA) is a systematic investigation of conditions within the environment of the proposed development or project followed by an assessment of the impacts that the development or projects have on the environment in totality, i.e. physical, biological and

socio economic aspects. The EIA Regulations, Statutory No. 28 of 1997 guides this process in Zambia.

ZEMA has been established as the governmental framework that authorises the mining licences through the use of an Environmental Impact Assessment (EIA) following Local Authorities and Ministry of Mines comment as well as community input through public hearing. A "full EIA" which is referred to as an Environmental Impact Statement (EIS) is required from a developer in Zambia when starting up a mine as mining activities are always considered having a large impact on the environment (Banda, 2016; Lindahl, 2014). One of the major steps in EIA and EPB is public participation through public hearing. How effective is this process and how do we ensure it covers the views of all the affected communities? Despite the law providing for the conservancy authority and community input, how does communities monitor compliance of their input and how can these stakeholders contribute to mining environmental compliance during the mining licence period? For details of EIA process, check Appendix 4.

Despite EMA giving mandate to ZEMA to regulate the mining sectors environmental compliance Lindahi (2014), Chifungula (2014) and as supported by Simutanyi (2008) states that the existing Zambian laws and regulations regarding environmental management and protection are adequate and up to date but their implementation has not been satisfactory. ZEMA has a lot of power and is continuously being strengthened as the legislation keeps improving. However, the agency is heavily understaffed and can only manage a few of its responsibilities in a satisfactory way but should this be the reason for failure to implement a successful environmental management strategy? What contribution can other conservancy authority like local Authorities make? This study compliments ZEMA's efforts in implementing a successful environmental management and compliance strategy within the country through engagement of Local Authorities (LA). A special concern is raised for the severe lack of supervision towards the industry after projects have been authorized and obtained all its licenses and permits. Engaging local authorities to monitor environmental management and compliance can help manage these institutional deficiencies.

2.3.3 Review of Relevant Regulations

The Local Government Act No. 2, 2019 provides for the establishment of Councils or local authority and their functions. Some of the functions relate to environmental management and

compliance, particularly pollution control. The act also provides under Section 17 (b) for the LA to join with the Government, another government institution such as ZEMA, with the approval of the Minister, in establishing and maintaining the undertaking, service or facility to safeguard human health and the environment. Inadequate coordination between LA and ZEMA has continued to create a very big gap in environmental management and compliance. Despite the power being conferred to LA to control pollution and considering mining environmental issues that have adverse effect on their services provision such as: water and sanitation and health related services, the local authorities have done less in managing such issues (Mbolela, et al., 2016). Mostly, local authority and mining companies have concentrated on Corporate Social Responsibility (CSR) as evidenced by (Harmon, 2017; Mines, 2017). Concerning CSR, mining stakeholders including the government, communities, NGO's, religious institutions and unions pushing for a greater redistribution of mining revenues increasingly find themselves coalescing around CSR (Negi, 2016). CSR is supposed to fulfil *capital's basic principles* and *environmental standards* but however, in Zambia it has been associated with charity, donation and capital contribution to the creation of physical and social infrastructure in the specific area in which the mine operates (Harmon, 2017; Mines, 2017).

The Solid Waste Regulation and Management Act No. 20 of 2018 provides for the sustainable management of waste to safe guard human health and the environment. Section 4 provides for LA to collaborate with appropriate authorities to ensure sustainable effective waste management.

The Urban and Regional Planning Act No. 3, 2015 provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land.

The Public Health Act, Cap 295 of the Laws of Zambia provides for the prevention and suppression of diseases and general regulation of all matters connected with public health in the country such as drainage, waste and air emissions and treatment of sewage. This is supported by **the Occupational Health and Safety Act of 2010** which provides for the health, safety and welfare of persons at work.

The Environmental Management Act No. 12 of 2011 is an umbrella and principal law which stands over all other environmental legislation in Zambia. The Act is mandated to ensure the sustainable management of natural resources and protection of the environment to provide for

human health and the environment. The following regulations have since been derived and applied together with the Environmental Management Act: The Environmental Management (Licensing) Regulations, 2013 which specifies requirements and provides long-term emission limits for all forms of environmental pollution, The Environmental Management (Extended Producer Responsibility) Regulations, 2018 and The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997.

The Water Resources Management Act No. 21 of 2011 provides for the management, development, conservation, protection and preservation of the water resources and its ecosystems.

For the purpose of enhancing wildlife ecosystems, **the Zambia Wildlife Act No 12 of 1998** gives Zambia Wildlife Authority the mandate to control and manage national parks, game management areas and bird sanctuaries. Exploration of mineral resources is not forbidden in national parks. Exploitation of mineral resources is not allowed if it will cause large environmental impacts.

Regulations specifically related to mines and minerals can be found in **the Mines and Minerals Development Acts No. 11 of 2015** which is a legal framework for prospecting and mineral resources development in Zambia. The Act stipulates regulations in acquiring prospection and exploration rights. It also deals with environmental issues pertaining to prospecting and exploration with reference to environmental impact assessment study before any prospecting rights is granted. This is supported by **the Mines and Minerals Environmental Protection Fund Regulations (SI 102 of 1998)** which outlines Environmental Impact Assessment and Audits in the prospecting sector concerning infrastructure such as mine dumps, storage areas and hazardous materials handling.

It also provides for setting up and operating an Environmental Protection Fund whose objectives include; provide assurance the developer shall execute environmental and social impact statements, and provide protection to the government against the risk of having the obligation to undertake rehabilitation of a mining area where the holder of the mining license fails to do so.

According to Lindahl (2014), other old Acts that complement the Environmental Management Act No. 12 of 2011 and are relevant and still being used to support and champion sustainable environmental management and compliance to safeguard human health and the environment includes;

- The Water Pollution Control Regulations (SI 72 of 1993).
- The Pesticides and Toxic Substances Regulations (1994).
- The Air Pollution Control Regulations (SI 142 of 1996).
- The Hazardous Waste Management Regulations (SI of 2001).

From the different legislation reviewed and enforced by different government institutions, it can be confirmed how their mandate are related to safeguard human health and the environment. Therefore, it can be said that environmental issues are cross cutting hence the need for an integrated environmental management system. This environmental integral approach should not be a one off activity but should be a continuous process to ensure effective management of all environmental dynamics.

2.3.4 Functions of ZEMA

According to the Environmental Management Act of 2013, ZEMA carries out the following functions:

i. Advise on formulation of policies on all aspects of the environment and sustainable management of the environment.

ii. Develop and enforce measures aimed at preventing and controlling pollution.

iii. Develop in liaison with other relevant appropriate authorities, standards and guidelines relating to the protection of air, land, water and other natural resources.

iv. Review environmental impact and strategic environmental assessment reports.

v. Mainstream environmental concerns in overall national planning.

vi. Research or sponsor research on emerging environmental issues.

vii. Conduct public education and public awareness.

2.3.5 Organisational Structure of ZEMA

ZEMA is headed by the Director General who is the chief executive officer. He is supported by four (4) directorates and these include: Operations, Legal, Planning, Information and Research and Finance and Administration. The Departments under the 4 directorates are headed by Managers.

The department directly involved in environmental management is operations and under the respective Managers are Principal inspectors who are the technical operatives according to units. These include Natural Resources and Climate Change, Pesticide and toxic substances, Water, Air and Noise (WAN), Environment Assessments and Waste Management Unit.

The Hierarchy in Figure 2.4 shows a detailed ZEMA structure under operations department: the director operations is directly assisted by manager south and north who are responsible for environmental management on the Southern and Northern side of Zambia respectively. The two managers are also assisted by principle inspectors who are heading the units stated above. The principle inspectors are supposed to be assisted by the senior inspectors but most of the position were vacant for most units at the time of research and data collection.

The principle inspectors are instead assisted by the inspectors under each unit on all environmental inspectorate, verification, monitoring and compliance related activities. The inspectors are supposed to be assisted by the technologists (assistant inspectors) whose positions were vacant at the time of data collection.

These vacancies have posed a challenge on ZEMA to carry out its mandate effectively and this have created gaps and weaknesses in the environmental monitoring and compliance system in the country.

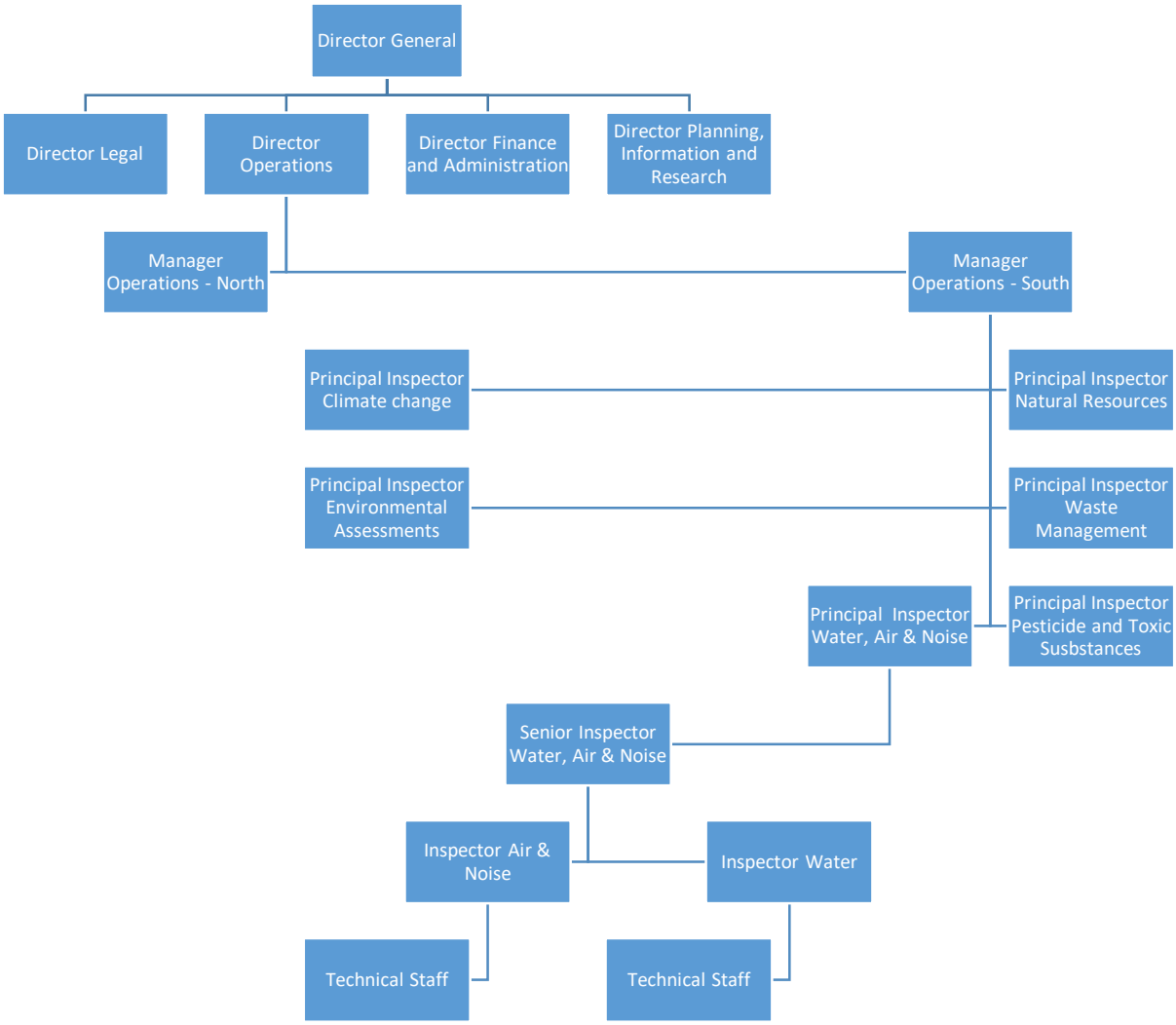

Figure 2.4: ZEMA's Hierarchy under Operations department in charge of Environmental Management

2.3.6 Functions of ZEMA Units

This study was limited to mining environmental issues with local effects and the units of interest included; Water, Air and Noise (WAN), Waste Management (WM), Pesticide and Toxic Substance (PTS) and Environmental Assessments (EA) Unit.

i. Water, Air and Noise Unit

The WAN unit is responsible for enforcing regulations of environmental issues related to air, water and noise pollution control. In addition, the functions included inspection of projects that have effects on the air and water quality as well as prescribing the sound levels in different land use and locations; further, the unit is also responsible for preparation of licence conditions for air emissions and effluent discharge, review of bi-annual statutory returns and advising on technical matters relating to water, air and noise pollution.

ii. Environmental Assessment Unit (EAU)

This Unit is responsible for advising developers on a systemic process to identify, predict and evaluate potential positive and negative impacts that a proposed project may have on the environment in its totality that is physical, biological and social-economic aspects. It's from this systemic process known as the Environmental Impact Assessment (EIA) that mitigation measures for the established positive and negative impacts are established and a decision may be made whether or not to proceed with the proposed project. The Unit further conducts verification inspections among other functions. ZEMA through EA only issues authorization as outlined in The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 after ascertaining that the proposed mining project will meet the three pillars of sustainable development namely social-economic development and environmental wellness.

iii. Pesticide and Toxic Substance Unit (PTS)

The unit is responsible for safe use and handling of chemicals through identifications of their specific hazards and subsequent communication of this information to users in a manner which can be easily understood. ZEMA has adopted the Globally Harmonized System (GHS) framework which is the worldwide system for classification and labelling of chemicals according to the hazards they pose to humans and the environment, this information regulation and management of pesticide/chemicals within the country. This was necessitated because 90% of chemicals used in Zambia are imported. The unit controls chemicals during exportation, importation, distribution, transportation, storage and registration. ZEMA has also identified pesticides/chemicals with

contain active ingredients banned for importation into Zambia. This is in accordance with the Stockholm Convention on persistent organic pollutants and the Rotterdam Convention on the trans-boundary movement of hazardous chemicals.

iv. Waste Management Unit

The unit is responsible for all processes and resources for proper handling of waste materials, maintenance of waste transportation vehicles or systems and dumping facilities to comply with health codes and environmental regulations. ZEMA has put in place adequate regulations to handle waste including generation, storage, handling, sorting and treatment with the aim of reducing waste generation so as to enhance human health and environmental wellness. Waste management includes; garbage, refuse, sludge and industrial/community discharges.

2.4 Integrated Environmental Management System

According to the **Local Government Act No. 2 of 2019** and **The Public Health Act, Cap 295 of the Laws of Zambia,** the above mining environmental issues are a public nuisance but yet the local authorities have done nothing regarding monitoring of such environmental annoyance. Additionally, Zambia's legislation and regulations regarding environmental protection are up-to-date but its implementation has not been successful (Lindahl, 2014; Banda, 2016). Despite many studies been done around environmental management, no study has been done regarding the contribution of local authorities to mining environmental management and compliance. This study therefore, seems to establish factors that have hindered local authorities from monitoring these environmental issues and establishes an environmental audit tool to aid local authorities in environment management and compliance.

Literature review has shown that environmental issues are cross cutting hence the need for integrated approach to environmental management which require engagement of key stakeholders such as local authorities and communities at sub-district level in monitoring mining operations to mitigate environmental issues and enhance compliance (Munnik et al, 2010). How then, can environmental authorities like ZEMA incorporate LA and communities in Zambian mining environmental monitoring strategy? Part V of the Local Government Act espouses the creation

and functions of the Ward Development Committees (WDCs) who's many objective is to participate in community developmental processes.

Government intention on community partnership as outlined in the Constitution of Zambia, the National Decentralisation Policy, the Local Government Act No. 2 of 2019 and supported by the Ministerial Guidelines of 2013 support the inclusion of a fourth level of Governance through the establishment of WDCs and Village Councils at Sub-district level for enhancement of community participation as shown in Figure 2.5. This hierarchy provide a very good platform to cover the entire Zambia in environmental monitoring and compliance system.

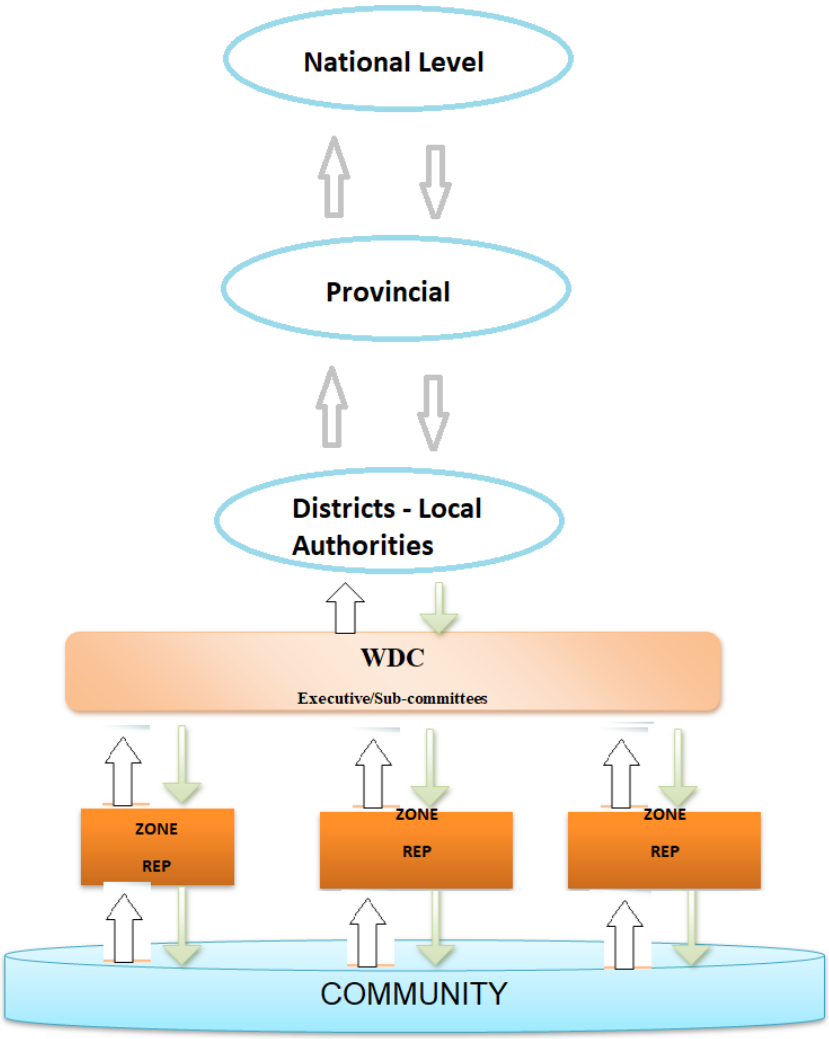

Figure 2.5: Zambia's governance system to be adopted in environmental monitoring and compliance system (Local Government Act No. 2 of 2019)

WDCs provide a linkage between the community and the Local Authorities in the development planning, financing, co-coordinating and managing the delivery of services in their respective areas. This promotes the 'bottom-up' flow of integrated development planning information from sub-districts to Central Government with the full participation of the community (Mbolela, et al., 2016). Regarding EM, community involvement will promote accountability and transparency in utilization of resources as well as safeguarding human health and the environment. This is also supported by the Constitution of Zambia (Amendment) Act No. 2 of 2016 and provides for the establishment of a platform through which the citizens of Zambia will participate in planning, monitoring and evaluation of development initiatives in their areas.

Two major reasons for the justifications of establishment of WDCs are to improve the living standards of its people through community participation in development processes and address issues of escalating poverty levels which is linked to environmental health and its wellness. Poverty has merely been caused by exposure to worst environmental health and risks (Kjellen, 2001). Other justification that relates to environmental management include; co-coordinating activities of different institutions/communities at sub-district level, empowering/training communities for self-help activities, raising awareness/disseminating information on issues affecting the communities (e.g., programs, policies, development projects), reporting results of activities to District Development Coordinating Committee (DDCC)/LA, providing a development link between the district and sub-district levels and monitoring and evaluating projects at grass-roots level.

Functions of Ward Development Communities as stated in the Local Government Act No. 2 of 2019 include but are not limited to the following (Mbolela, et al., 2016):

1. Prepare annual ward development plans
2. Collect revenue, levies and fees on behalf of a local authority on appointment by resolution of the council. WDCs have worked excellently well in revenue collection and LA has established and realised established wide financial bases.
3. Monitor and evaluate ward development projects. This is one of the major outcomes of this study through the proposed environmental audit tool to empower communities to monitor projects compliance within their area.
4. Promote community engagement in ward development planning

5. Formulate and submit project list and budget proposals to the Constituency Development Fund Committee established under the Constituency Development Fund Act, 2018
6. Support research on an area of study for the advancement of the local community;
7. Facilitate the identification of potential areas of investment and promote sustainable local economic development
8. Promote and participate in the co management of natural and trans-boundary resources between or among wards
9. Provide a forum for dialogue and coordination on ward development issues
10. . Identify areas for capacity building within the ward;
11. Promote and encourage village regrouping and urban renewal activities;
12. . Identify in the ward, and submit to the local authority, potential areas of revenue sources likely to broaden the revenue base of the local authority;
13. Prudently manage resources allocated to the ward by the local authority in line with principles of public financial management
14. Manage and keep a record of resources allocated to the WDC
15. Prepare quarterly reports on developmental activities within the ward to the appropriate committee of the local authority
16. Develop and maintain a ward based database as guided by the local authority.

2.5 Zambia's Developmental Agenda

Zambia's developmental agenda is aligned with Zambia's development priorities as articulated in a number of strategy plans and polices including the National Long Term Vision 2030 (NLTV), the Sixth National Development Plan (SNDP), the Revised Sixth National Development Plan which is now the Seventh National Development Plan (7NDP). This is coupled with international and sub region agreement aimed at supporting sustainable development (Masinja, 2015).

Zambia is one of the African countries committed to attain sustainable development goals by 2030 through: "an inclusive pathway that leaves no-one behind, prosperous and peaceful nation, where economic and social development is equiTable, where human rights and rule of law are upheld, where there is gender equality" and through support of sustainable approaches and environmental

resilient programmes and practices (United Nations Country Team, 2016). Despite Zambia making remarkable economic progress and government's commitment to sustainable development goals (SDGs), the fact still remains that more than 60 % of its 16 million populations remain poor. Additionally, the efforts to attain SDGs are proving quite difficult to achieve (Masanta, 2017). In order for social-economic success to be realised, African countries need to focus on social-economic policies that support human and ecological wellbeing (WeAfrica, 2018). As outlined in the Zambia Vision 2030 and Zambia's Seventh National Development Plan 2016 - 2021 (SNDP), the National Decentralisation Policy and supported by (KIN, 2012; Zambia, 2008), this sustainable social-economy development can only be achieved through engagement of all key stakeholders through partnerships and working together of institutions such as government, communities and private sector as shown at stage 5 and 8 in Appendix 4 of the EIA process: since we live in a planet were we depend on each other for survival (ecosystem), working together will alter the way people think about resource development and help realize a more meaningful existence of all citizens through prosperity and elimination of poverty.

Zambia should get to a level where raw material producers, extractive industries and manufacturers should be focusing not only on profit making but prioritising social and community related issues in there day to day activities: this could only be realised by increasing pressure from all stakeholders especially at local level to make extractive industries responsible for social, economic and environmental impacts of their activities in their respective areas of operation (Coulson, Ledwaba, & McCallum, 2017). Such will shifted countries attention from not only consider Gross Domestic Products (GDP) as a standard to measure the countries progress which only accounts for production and consumption, but also include improving human well-being and the environment (Parr, Randolph, & Remer, 2015). As supported by the National Decentralisation Policy (NDP) which gives citizens through the Local Authority power to exercise control over its local affairs and foster meaningful development. It ponders on the need to transfer to local authorities, functions and responsibilities, with matching resources (Zambia, The National Decentralisation Policy, 2013). Some of the functions in the NDP and as supported by the Local Government Act related to safeguarding human health and the environment include;

i. pollution control;

ii. District health service (primary health care, environmental health and public health services);
iii. control of public nuisances;
iv. solid waste management;
v. environmental management;
vi. soil conservation;
vii. management, conservation of natural and wildlife resources;
viii. environmental services

The NDP helps citizens to exercise control over its local affairs and foster meaningful development and this dissertation provides the platform through the establishment of the mining environmental audit tool for lower level participation in environmental management, monitoring and compliance to enhance sustainable development. The most three major players in mining are the Government, the investor and the Community but Masinja (2015) emphasis on the complexity of the industry and the need for stakeholders who understand its dynamics. This study also identifies areas of weakness in the Zambian environmental management, monitoring and compliance regulation systems, devising and implement an appropriate response that is more engaging (local authorities and communities) for monitoring results and learning to ensure progress through creation of a healthy environment that supports human wellbeing and reduce poverty (Kjellen, 2001).

2.6 Functions of Local Authorities in Zambia

Article 152 (1) of the Constitution of Zambia provides that a local authority shall: administer the district; oversee programs and projects in the district; make by-laws; and perform other prescribed functions. Solwezi Municipal and Kalumbila Town Councils are responsible for provision of these services to the people living within its boundaries. These services are wide-spread; some of the core services are pollution control, fire related services, solid waste management, provision of adequate clean water and sanitation and environmental management.

i. Solwezi Municipal Council Institution Framework and Organogram

Solwezi Municipal Council is an autonomous body whose administrative organizational structure is composed of six Departments namely; Human Resource and Administration, Finance and Business Development, Planning and Information systems, Engineering and Infrastructure Development, Public Health Services and Housing and Social Services. The office of the town clerk is responsible of institutional management and coordinates the other, aforementioned, Departments. In the following chapters, the Engineering Services and Public Health Departments are described and their main tasks and responsibilities highlighted.

For the sake of this study, we will only discuss the relevant Departments namely Engineering Services and Public Health.

a. Department of Engineering Services

The Department of Engineering Services is accounTable for the appropriate provision, supervision, coordination and management of all engineering works within the municipality of Solwezi, pursuant to the provisions of engineering, fire, and infrastructural services.

The Department of Engineering Services has 9 Sections namely: Administration, Mechanical, Electrical, Fire and Rescue, Architectural, Quantity Surveying, Roads and Drainage, Parks and Gardens and Building Construction and Maintenance Sections.

The department is accounTable for the appropriate provision, supervision, coordination and management of all engineering works within Solwezi Municipal, in pursuant to the provisions of the Town and Country Planning Act, Public Health (Building Regulations) Act, and other statutory provisions.

The major responsibilities include life-saving, fire services, and road maintenance and regulating building standards. The department working together with the Public Health Department are responsible for safe guarding human health and environmental wellness.

b. Public Health Department

Public Health Department has different operational Sections. These Sections are specialized and charged with the responsibility of ensuring that the council services are delivered to the residents of the Solwezi District. The Sections are as follows;

- Cleansing Section
- Inspectorate Section
- Pest control Section
- Funeral Section
- Health Promotion Section

Cleansing Section (Waste Management Section)

Background of Waste Management

The Department of Public Health was officially formulated in late 2017 when the local Government Service Commission appointed the first ever Director of Public Health at the Municipality. Since the inception, the department has received a number of technical staff which has now seen it expand into five (5) Sections which provide numerous services to the public such as; Pollution Control, Waste Management and Cleansing, Inspectorate, Funerals, Pest Control and Health Education & Promotion. The Public Health Act Cap 295 of the Laws of Zambia mandates the Local Authority to provide waste management and cleansing services to all its citizens in its jurisdiction as well as to properly manage solid waste from point of generation, collection, transportation, separation, reuse, recycle, treatment to energy recovery and or incineration/final disposal of all municipal waste.

Functions

Public Health Department Waste Management Unit is a department under Solwezi Municipal Council mandated to provide environmental and solid waste management services from point of generation, collection, transportation, sorting, recycle, treatment, compositing, energy recovery,

incineration and dispose at minimal fee. The unit is mandated to manage both hazardous and non-hazardous waste from industries and residential houses in Solwezi to safe guard human health and the environment.

ii. Kalumbila Town Council Institutional Framework

Kalumbila Council is an autonomous body whose administrative organizational structure is composed of four departments namely; Human Resource and Administration, Finance, Planning and Works. The office of the Council Secretary is responsible of institutional management and coordination of all aforementioned departments among other devolved functions. In the following chapters and for the sake of this study, Works and Planning departments are described in details.

a. Works Department

Works Department is accounTable for the appropriate provision, supervision, coordination and management of all engineering works under Kalumbila Town Council. One of the major responsibilities includes life-saving, fire services, and road maintenance.

The Department has 6 Sections namely Mechanical, Adequate Clean Water and Sanitation, Fire and Rescue, Roads and Drainage, Parks and Gardens and Building Construction and Maintenance Sections.

The Department works in collaboration with the Planning Department to provide public health service and safe guard the environment.

b. Planning Department

Public Health Section is one of the major units under this department. The unit is specialized and charged with the responsibility of ensuring that the council safeguards human health and that of the environment. The Section is responsible for; pollution control, waste and environmental management, cleansing, inspection, Pest control, body disposals and health education and promotions.

The Public Health Act Cap 295 of the Laws of Zambia mandates the Local Authority to provide waste management and cleansing services to all its citizens in its jurisdiction as well as to properly manage solid waste from point of generation, collection, transportation, separation, reuse, recycle, treatment to energy recovery and or incineration/final disposal of all community waste.

Chapter 3

Methodology

3.0 Introduction

This Chapter discusses the various steps that were undertaken by the researcher to explore the objectives of the study which included: to determine factors that have contributed to weak monitoring of mining environmental issues by Local Authorities and to design an environmental audit tool that could be adopted by Local Authorities to aid in environmental management and compliance to safeguard human health and the environment. The study adopted both qualitative and quantitative methods known as the Mixed Method (MM) because of its ability to alleviate the weaknesses and provide richness and details that are otherwise unavailable if each method were to be pursued separately (Amaratunga et al, 2002; Bryman, 2001; Creswell, 2003; Teddlie & Tashakkori, 2009) . The use of a Mixed Method approach was rooted in both philosophical and practical reasons, which are explained in detail to justify the Mixed Method approach for this Dissertation.

The Chapter consists of the following Sections: study location, the research design, research approach and the Delphi method.

3.1 Location of the study area

North-western Province is located between latitudes 10˚ 4’ and 14˚ 00’ south, longitudes 22˚ 00’ and 27˚ 10’ East; Solwezi district and Kalumbila district are within the same boundaries. The study used Solwezi and Kalumbila district as case study because the districts are currently housing three biggest copper mines in Zambia which includes Kalumbila, Lumwana Plc and Kansashi Plc. The 40 participants from Local authorities, mining representatives and community representatives were purposely sampled for this study to establish factors that affect efficient monitoring of mining environmental issues (Malambo, 2013).

3.2 Research Design

The Mixed design approaches was adopted in the study to obtain answers from key important institutions, stakeholders and knowledgeable people involved in mining environmental management and compliance in Zambia, ZEMA and LA.

3.2.1 Sampling

Due to financial and time limitation, it is impossible to analyse the entire population of a study area hence the need to sample selected study elements from a population (Banda W. , 2016). The sampling process was conducted through a well-defined staged process which includes; clearly defining the target population, select sampling frame work, choose sampling techniques, determine sample size, collect data and assess response rate (Taherdoost, 2016). Figure 3.1 shows two general sampling techniques namely, probability and non-probability sampling which are well articulated by (Banda W, 2016; Taherdoost, 2016).

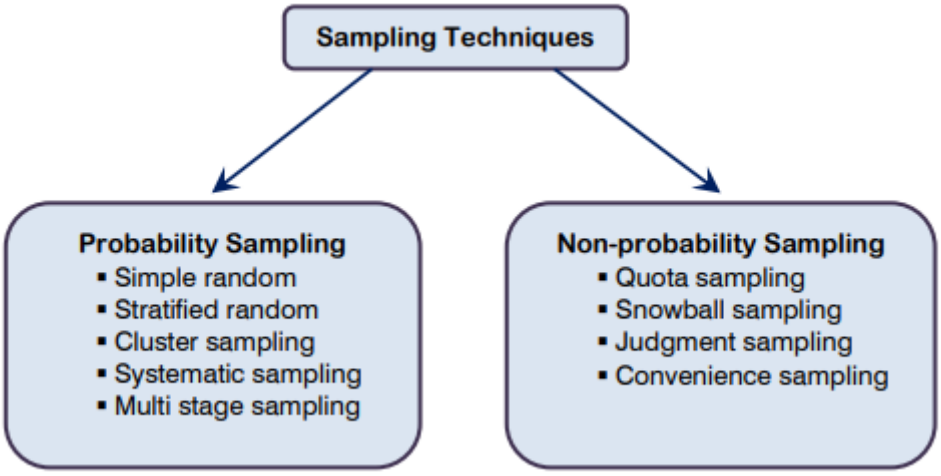

Figure 3.1: Sampling Techniques (Taherdoost, 2016)

This study adopted the Non-probability sampling as it is associated with case study research design and qualitative research. "The research used the purposive and convenient sampling. Purposive or judgmental sampling is a strategy in which particular persons or events are selected deliberately

in order to provide important information that cannot be obtained from other choices" (Taherdoost, 2016). Convenience sampling is selecting participants because they are often readily and easily available.

Solwezi and Kalumbila district were purposely selected as they are hosting three biggest coppers mines in Zambia and stand a great risk to mining environmental impacts. Solwezi is divided into five (5) wards each represented by a councillor with a total population of 126,182. The wards are further divided into zones which are represented by zonal leaders who are part of the Ward Development Committee were eight (8) executive representatives are elected. The Public Health Department is Section responsible for environmental related activities under Solwezi Municipal Council. The Department has eight (13) Environmental Health Inspector and help staff.

According to the 2010 Census of Population and Housing, Kalumbila has a population of 85,505. The district is divided into ten (10) wards which are represented by councillors. 8 WDC executive are community leaders elected from each zone within the district. Planning department is responsible for environmental related activities with a departmental return of 11 planning and health inspectors and help staff.

From a total of 15 wards and 16 elected WDC executive members from the two district, 10 councillors, 5 from each district and ten (10) WDC executive representative, 5 from each district especially those within or near mining houses were purposively and conveniently selected by the researcher to represent the community. Ten (10) council officers comprising of heads of departments, engineers and health inspectors from each council were purposively and conveniently sampled because of the knowledge and information they hold on environmental related subject. The distribution of questionnaires was based on who is readily available from the selected participants to achieve the first study objective. The primary data obtained from questionnaires was analysed using Statistical Package for Social Science (SPSS) and Excel to deduce factors that have hindered LA from monitoring mining environmental issues.

Guided interviews and observation were administered during a six (6) weeks internship at ZEMA Lusaka conducted by the researcher to get required information in respect with the second study objectives.

3.3 Research Approach

The research was achieved by targeting the following important key institutions and stakeholders involved in environmental management and compliance in Zambia.

i. **Objective 1:** Information about factors that have led to weak monitoring of mining environmental issues was obtained from literature reviewed, Zambian regulations and policies on environmental management combined with information analysis from questionnaires. Questionnaires were purposively and conveniently sampled among 40 (forty) participants (20 Council Officers, 10 Councilors and 10 Ward Development Committee (WDC) Executive Representatives). The 40 Questionnaires were divided into two halves between Solwezi and Kalumbila Council respectively. The 10 council officers responsible for environmental related activities from Solwezi and Kalumbila Councils represented 80% of the Public Health Services Department and 95% Planning Department respectively. Five (5) of each councilors and community executive representatives from each council represented 100% and 50% councilors from Solwezi and Kalumbila respectively and 63% WDC executive representatives from each council. All representatives were purposely and conveniently sampled because of their responsibility, knowledge and the type of information they held which was necessary for the study. Information obtained through the questionnaires included; benefits of mining, environmental impacts of mining, established mining environmental mitigation measures put in place in Solwezi and Kalumbila Districts and finally factors that hinder local authorities from monitoring mining environmental issues. The information was obtained by distributing questionnaires coupled with interviews to the identified participants based on availability basis. The information was analyzed using SPSS into a presenTable form to deduce factors that have hindered the Local Authorities to monitor mining environmental issues. Recommendation was given which formed part of the information for formulation of an audit tool.

ii. **Objective 2:** Information to design an environmental Audit Tool was obtained from Zambia Environmental Management Agency (ZEMA), an institution tasked to provide for ***integrated*** environmental protection and conservation and sustainable management and

use of natural resources. ZEMA was purposely chosen to perform a benchmark study regarding environmental management and compliance. Information was obtained through a 6 weeks internship aimed at understanding the current mining environmental management strategies used in Zambia. Information was acquired from the Environmental Impacts Assessment (EIAU) Unit on how to systematically identify, predict and evaluate potential positive and negative impacts that a proposed project may have on the environment in its totality that is physical, biological and social-economic aspect and how to conduct an environmental verification exercise. Information gotten from Water, Air and Noise (WANU) and Waste Management (WMU) Units was biased towards water, air and noise pollution control and sustainable handling of waste and how to prepare water, air, noise and waste disposal licence conditions respectively depending on the developments environmental impacts. Data collected from Pesticide and Toxic Substance Unit (PTSU) was concerned with handling of chemicals through identification of their specific hazards and subsequent communication of this information to end users. Info was acquired through 10 days active departmental participation attachment each to EIAU and WANU respectively and 9 days attachment each to WMU and PTSU respectively. Finally, information was logically and technically compiled to design an environmental audit tool that can aid Local Authorities in monitoring future mining environmental issues.

3.4 The Delphi Method

The Delphi Method was used in this research to establish an environmental audit tool that may be adopted by local authorities. According to Buckley (1995), the Delphi Technique is a qualitative methodology seeking to produce a consensus of a group of experts on an issue of concern through a survey consisting of rounds. The Delphi Method makes use of intuitively available information of the participants, who are mainly experts in their various fields. The participants included ZEMA staff.

There is agreement that Delphi is an expert survey in two or more ‘rounds’ in which the second and later rounds of the survey (the results) of the previous round will be given as feedback (Cuhls, 2003). In this research, the first round was to understand the mining environmental management strategy which ZEMA uses through information obtained from different units under ZEMA’s

Department of Operations. Results were then used in the second round to establish weaknesses and gaps in this strategy. Finally, results were analysed and logically presented to establish an environmental audit tool for local authorities.

The method was intended to remove the bias that may be possible when diverse groups of experts meet, which are common with other methods of decision making. With the Delphi Method, the experts did not know who the other experts were. Hence, the Standard-Delphi-Method was a survey, which was directed by the researcher and had comprised of two rounds with a group of different experts from different units, who were kept anonymous and for whose subjective intuitive contributed to attaining of study objectives. In the Delphi method, no expert was exposed or 'loses face' since the study was done anonymously using interviews and observations and this provided a better platform for experts to interact at professional level.

The interview was done by first explaining to the participants what the research intended to achieve at the end of the study and how information received from participants would be treated to safeguard the interests of all participants/respondents. The next segment of the interview involved asking questions based on interview guide.

Chapter 4

Results and Discussion

4.0 Introduction

This Chapter presents an analysis of all the data gathered by the approach of the methodological framework discussed in Chapter 3. It discusses the research findings and answers questions posed in Chapter 1.

The Section presents findings from analysed questionnaires by first presenting the benefit of mining to the two districts, environmental impacts management by three mining houses and the mitigation measures put in place to manage impacts. The Section also outlines factors that have led to weak monitoring of mining environmental issues by local authorities in Zambia.

The Chapter also identifies gaps and weaknesses against their appropriate response as contained in the EAT. The Section ends by presenting the recommended environmental audit tool for Kalumbila and Solwezi District Councils.

4.1 Responses from Questionnaires

Table 4.1 shows detailed response rate from the questionnaires submitted to Solwezi and Kalumbila Council. Out of the 20 questionnaires administered to Solwezi Municipal Council, 16 responded transcending 80% response rate. At Kalumbila Town Council, 17 responded from the 20 questionnaires submitted representing 85% response rate.

Table 4.1: Number of respondents in Solwezi and Kalumbila districts

Description	**Parameter**	
Institution	Solwezi Municipal Council	Kalumbila Town Council
Questionnaires Submitted	20	20
Questionnaires Responded to	16	17
% Response Rate	**80%**	**85%**
Total Respondents from both councils	**33**	

4.2 Benefits of Mining in Solwezi and Kalumbila Districts

Chapter 1 shortlists several benefits of mining to the surrounding communities and the nation as a whole. Mining has been identified to be one of the major contributors to the global economy. Literature reviewed has shown that mining in Zambia has played a key role in infrastructure development, economic growth, social development and poverty alleviation. The study through questionnaires as shown in Figure 4.1 has established a number of mining benefits to Kalumbila and Solwezi districts.

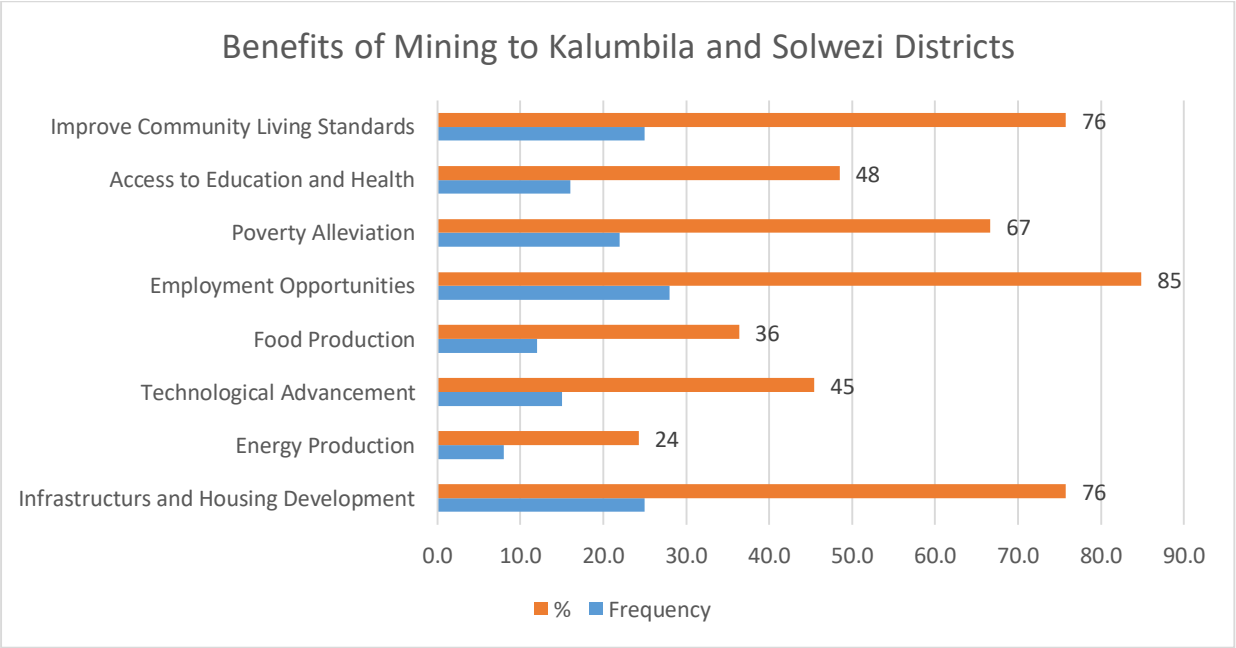

Figure 4.1: Benefit of mining in Kalumbila and Solwezi Districts

Results shown in Figure 4.1 indicate that 85% of the respondents indorsed that mining has brought employment opportunities to the two districts. Infrastructure and housing development and improved community living standards were each at 76% followed by poverty alleviation which was at 67%. Benefits such as employment opportunities for the locals has helped improve community living standards which has contributed positively to poverty alleviation in the two districts. On the other hand, infrastructure and housing development has assisted Solwezi district move from a rural district to an urbanised district. At minor level, mining has also effected the following beneficial changes; improved access to education and health, technological advancement, food production and energy production which stood at 48%, 45%, 36% and 24% respectively. Improved access to education and health through construction of new schools and clinics has contributed to improve human health, literacy levels, technological advancement and energy production. Food production through support of agriculture programs is one of the mining commitment to ensure a productive and health environment so as to safeguard and support diverse life on the environment and to help surrounding communities not depend on mining for their livelihood and also prepare the community for the post mining livelihood.

Despite the benefits of mining in both Kalumbila and Solwezi districts, the two districts have been hit with a lot of social and environmental issues as shown in the Pie Chart in Figure 4.2. Land degradation with a response frequency of over 27 and percentage of 82% was identified as the major environmental issue caused by mining waste management and results into loss of land opportunities for food production, infrastructure development and other diverse land use. Air pollution, soil contamination and water pollution were among other mining environmental issues that were identified in the districts with a variation of more than 26, 23 and 22 number of respondents affirmed this position transcending to 78%, 70% and 67% respectively. Air pollution has mainly been caused by emission from processing plant while water pollution has been caused by disturbed underground aquifer due to mining activities and surface acid mine drainage formation causing pollution on both surface water bodies and ground water. Soil contamination was mainly caused by poor and unsustainable mining waste management. Further, noise pollution with a frequency of 4 representing 12% was added to the list of identified environment impact in the two districts which is caused by mining operations. Apart from the identified mining environmental issues, two (2) of the respondents represent 6% of the added high cost of living for those not employed by the mines as one of social impact of mining in the district.

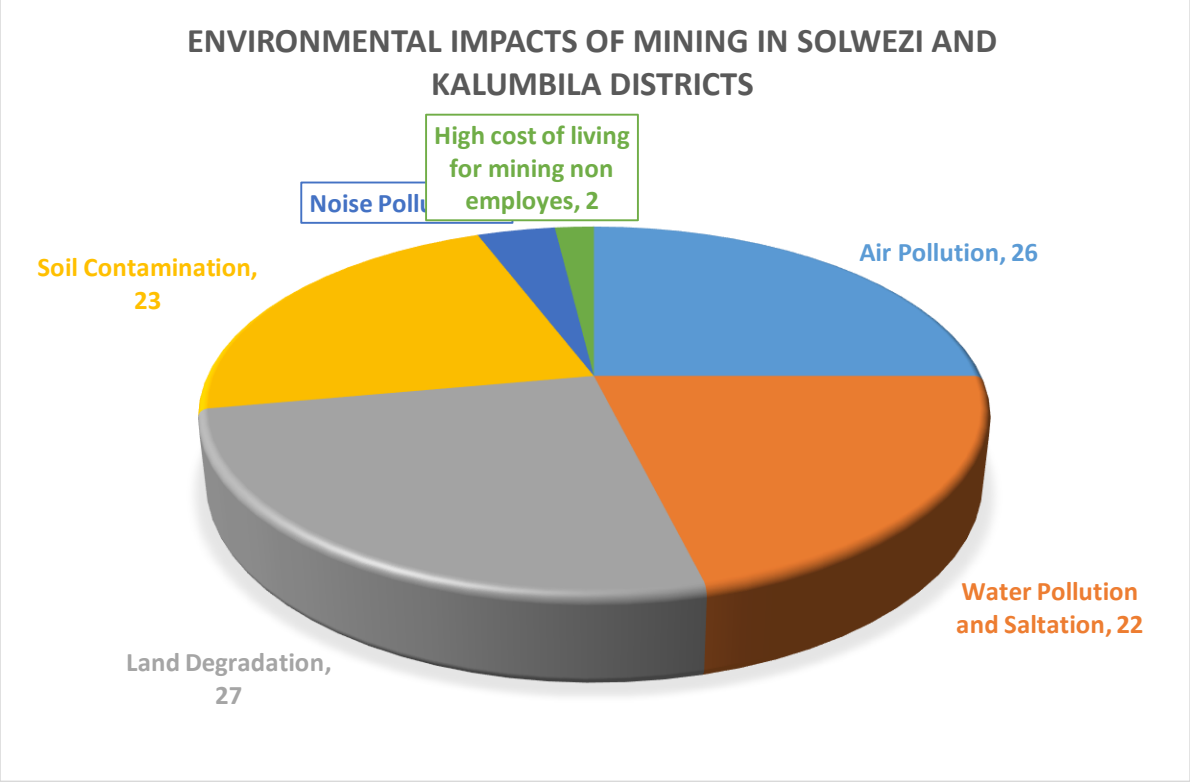

Figure 4.2: Environmental and Social impacts of mining in Solwezi and Kalumbila districts

With all these environmental issues, it was prudent to then establish if the two local authorities know of any measure that the three mining giant houses have put in place to prevent or mitigate identified mining environmental impacts. Figure 4.3, shows that 70% of the respondents confirmed that the mining houses have put in place engineered tailing dams to prevent further land degradation, soil contamination and air and water pollution. About 64% of respondents also confirmed boreholes have been drilled and stalled as a mitigation measure to monitor the quality of underground water. Almost 61% of respondents confirmed that insertion of advanced air emission monitoring and purification devices was the technology employed by the mines to prevent further air pollution despite literature reviewing that use of such technology is uneconomical for mining houses. Other mitigation measures such as prevention of acid drainage representing 55% through securing of waste rock and other mining waste was another approach that the mining houses have put in place to prevent further environmental issues. The respondents also added at 12% support of conservative programs by mining houses as stated under benefits

of mining above as another approach that the mining houses have adopted to combat environmental issues as well as strengthening climate resilience.

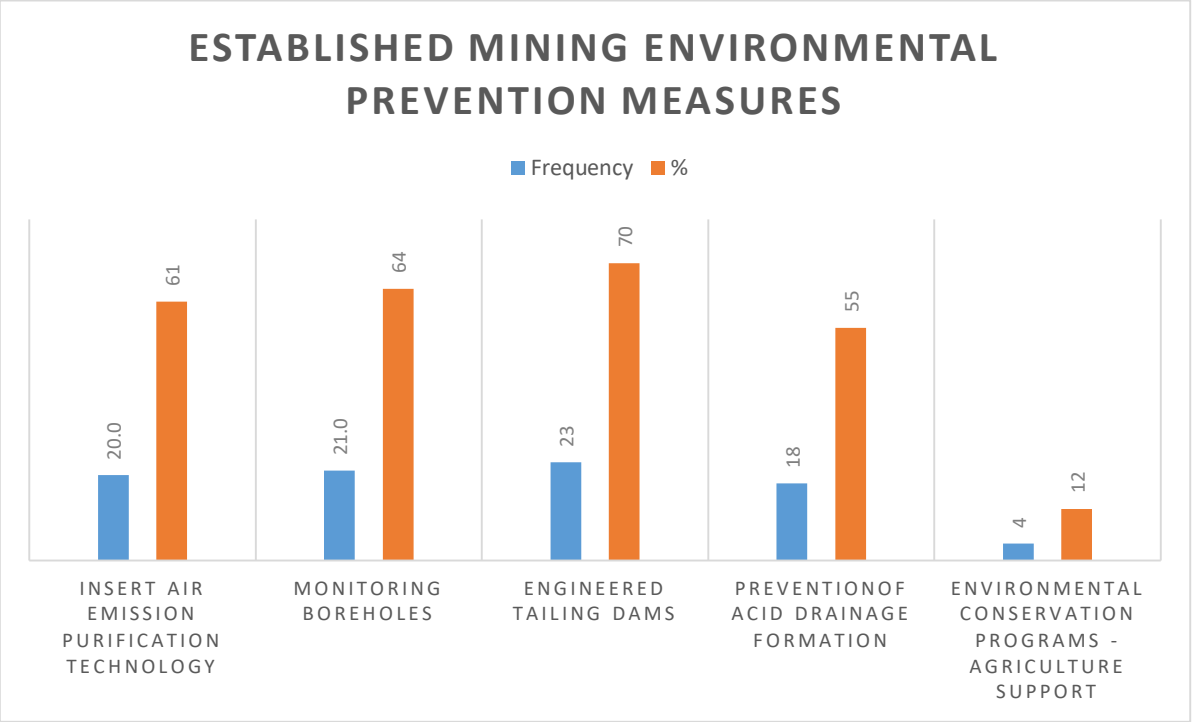

Figure 4.3: Mining mitigation measures put in place by mining houses in Solwezi and Kalumbila districts

4.3 Factors that Hinder Local Authorities from Monitoring Mining Environmental Issues

i. Lack of collaboration between Local Authorities, ZEMA and Conservancy Authorities.

Environmental issues are cross cutting hence the need for an integrated environmental management kind of approach. This integral approach should ensure continuous engagement of all stakeholders. According to the Environmental Management and the Local Government Act, local authorities are required to make comments on any development projects to be undertaken within their respective districts. In the past, Zambia Environmental Management Agency has expressed concern over non response by local authorities while local authorities have also expressed concern over late recipient of Environmental Project Brief or Environmental Impact

Statement for comments thereby giving the local authorities inadequate time to conduct verification exercise.

Figure 4.4 shows results obtained from the respondents about the need for integrate environmental management in Zambia among diverse authority. From the respondents, it is clear that there is need for ZEMA, local authorities and other conservancy authorities to coordinate in order to enhance environmental management in Zambia. A frequency of 22 participants transcending to 66.7% confirmed as major the need for integrated environmental management. Collaboration among conservancy authority as much as it is cardinal in safeguarding human health and that of the environment will require consented efforts and innovative ways from conservancy authorities such as that presented in the EAT. The minimal percentages of 18.2% transcending to a frequency of 6 participants and 12.1% corresponding to 4 participants affirmed on medium and minor respectively also reflects on the importance on the need for collaboration in Environmental Management.

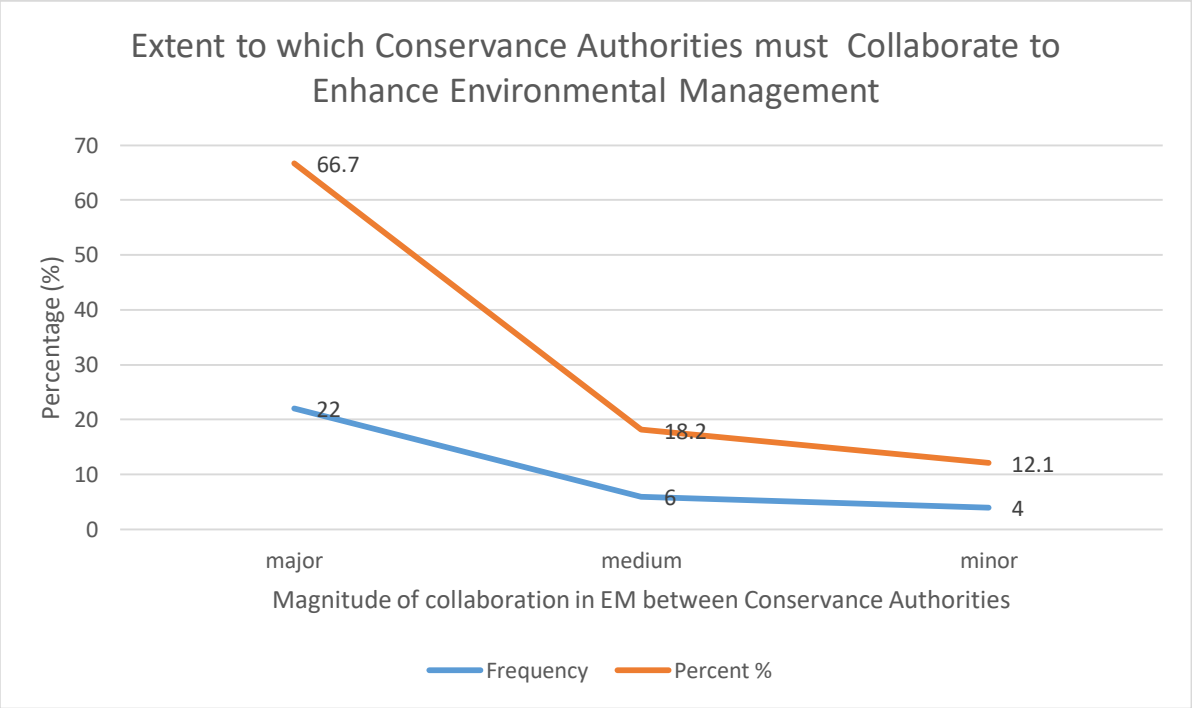

Figure 4.4: Extent to which Conservancy Authorities must coordinate to enhance Environment Management

ii. Lack of Knowledge in sustainable mining and mineral development

Beside the social economic development resulting from mining, there has been now, enormous recognition of the adverse impacts that mining has on the environment hence the need for sustainable mining (Azam, 2008). The five most important areas that sustainable mining should include: Environmental wellness, Economic development, Community engagement, Safety and Resource Efficiency (Kirsch, 2010).

Results obtained in Figure 4.5 shows that there is diminutive knowledge and understanding of sustainable mining by local authorities. 61% of the respondents prioritized economic development as a major pillar that define sustainable mining compared to environmental wellness and social equality which was at 39% and 18% respectively. It is clear that sustainable mining should be a balance of the three pillars of sustainable development including; economic development, social equity and environmental wellness. The respondents variation (major, medium and minor) over the prioritized sustainable mining pillars results entails that local authorities as one of the key stakeholders in environmental management need to be well informed and capacity built in sustainable mining to ensure equiTable balanced development.

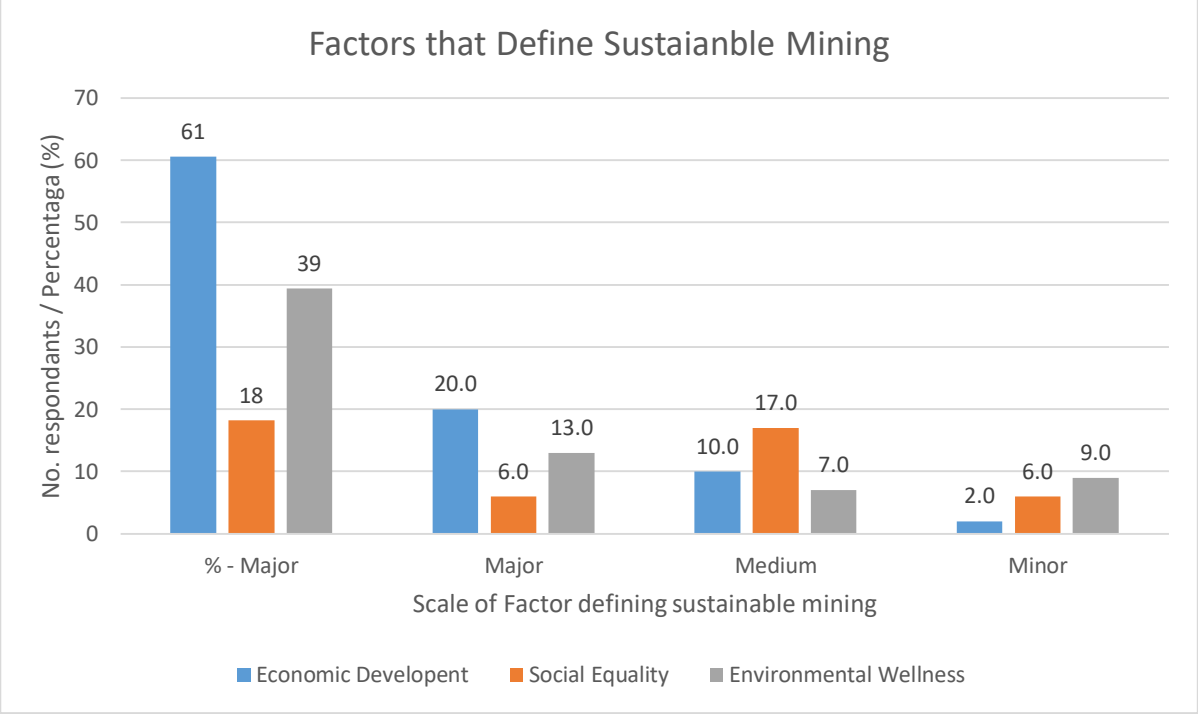

Figure 4.5: Scaling factors of sustainable mining by Solwezi and Kalumbila District Councils

Local authorities need to be well informed and continuously engaged so that from the inception of such mining projects they are able to establish or put in place parameters that will help them achieve social economic development and environmental wellness.

Lack of knowledge in sustainable mining can also be attributed to local authority's prioritized role were revenue collection was 85% prioritized with a frequency of 28 compared to pollution control, development control and domestic waste management which scaled 73% , 67% and 64% transcending to a frequency 24, 22 and 21 respectively as shown in Figure 4.6.

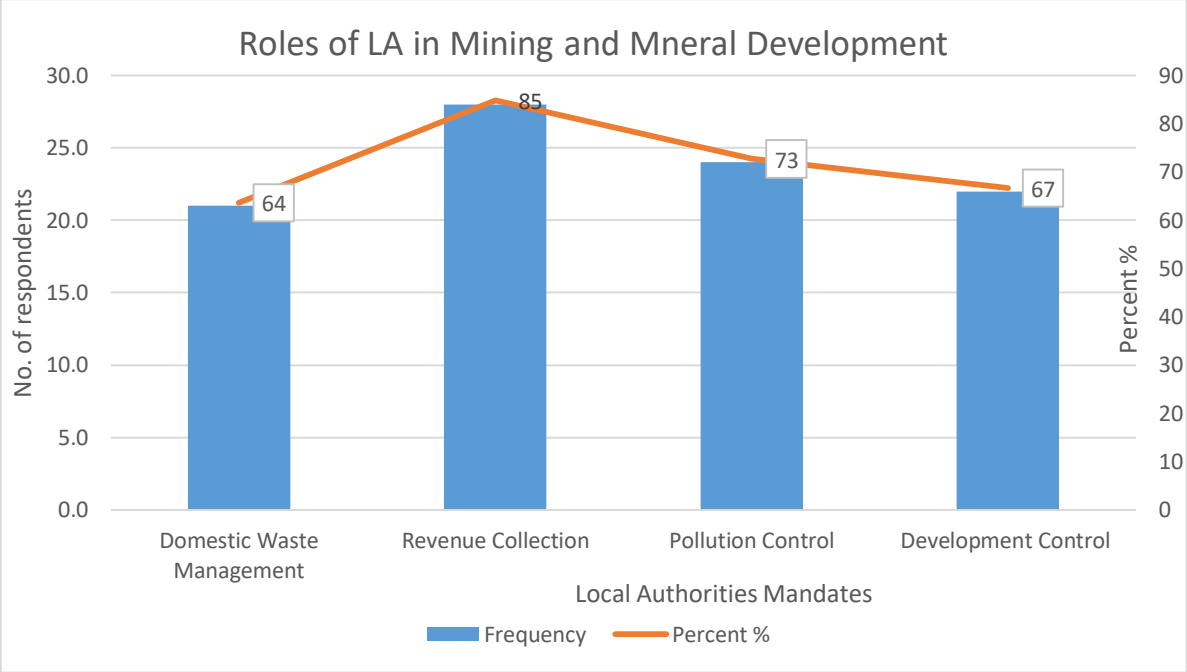

Figure 4.6: Scaling roles of Local Authorities in Mining and Mineral Development

iii. Lack of Human Resources

Lack of technologist field public health extension office from ZEMA and local authorities has posed a challenge to supervise mining after licence and just resorted to depend on the developer's biannual environmental compliance (BI) Returns which the two institution have no input. Lack of technical capacity to monitor environmental issues is another factor that has continued to hinder local authorities to monitor mining environmental issues. Civil engineers, environmental health

inspectors, planners and public health officers are occasionally in the field to monitor environmental issues.

ZEMA working together with local authorities can provide capacity building to local authorities technical staff and Ward Development Communities in environmental monitoring and compliance to overcome this deficiency and ensure that every corner of the 116 districts of Zambia is covered to safeguard human health and environmental wellness as proposed in the EAT.

Figure 4.7 shows that the Local authorities despite not having mining professionals and technologists have enough engineers (67% and 9%) with frequency (22 and 3), Environmental Public Health Officers at 88% with frequency 29 who may work in collaboration with ZEMA to increase technical capacity so as to enhance environmental management and protection.

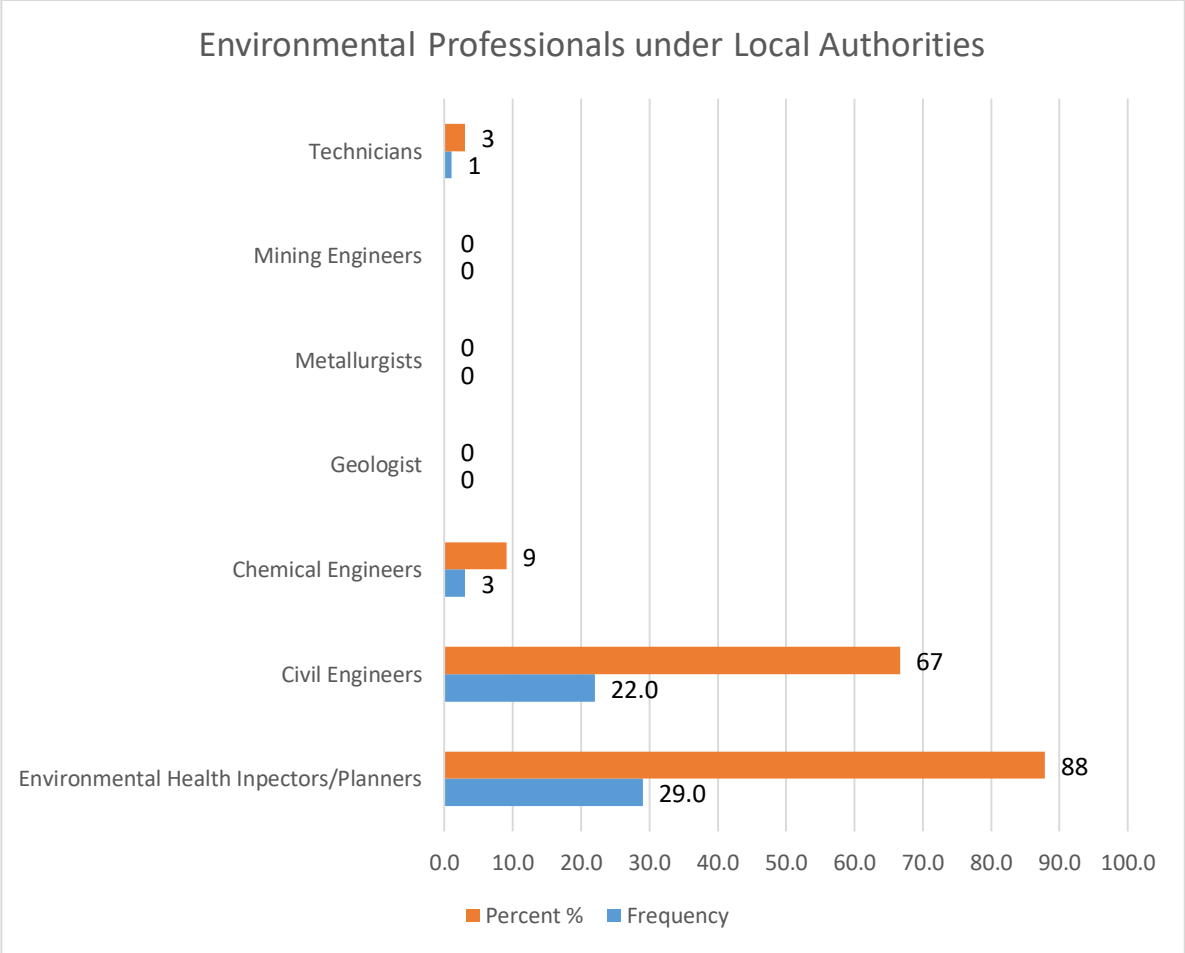

Figure 4.7: Number of Technical Professionals under Solwezi and Kalumbila Councils

iv. Lack of Local Authorities Engagement during Mining Licences Period

Lack of collaboration among conservancy authorities can at a large scale be attributed to lack of engagement of local authorities during mining licences period. The Zambia Environmental Management Agency (ZEMA) does not inform the Solwezi and Kalumbila Councils of the proceedings after submission of comments on a development project. The two local authorities are also not informed about conditions governing the licence hence they are not aware of the air and noise emission and water discharge limits. Collaboration to enhance environmental management should not be a one off thing, it should be continuous and all stakeholders kept well informed so as to help manage and monitor mining operations efficiently and successfully.

Lack of engagement of local authorities during mining licence period was ranked 2nd at 58% as shown in Figure 4.8. This shows the importance of continuous engagement of LA in environmental management and compliance.

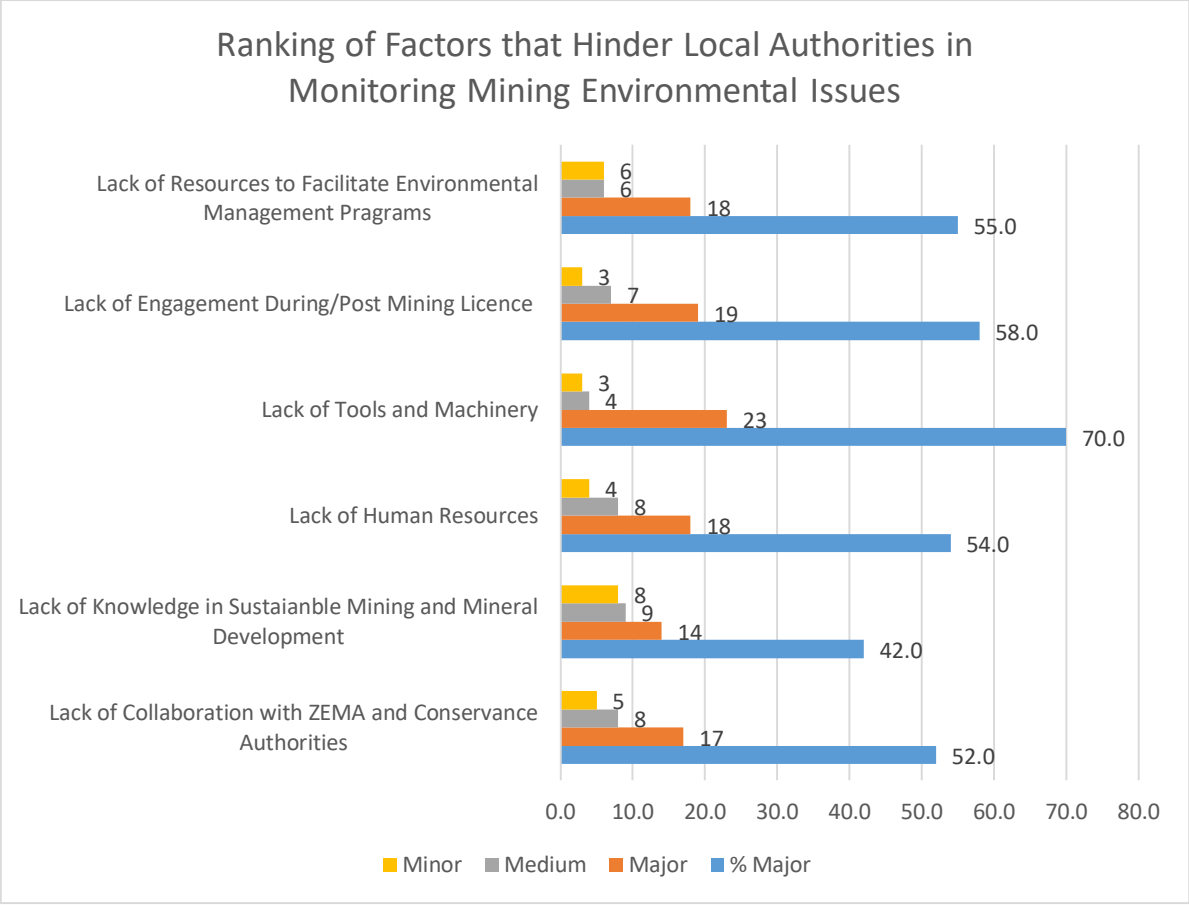

Figure 4.8: Ranking of factors that hinder LA from monitoring mining environmental issues

Results of this study indicate that ZEMA has at many times not advised local authorities on conditions governing mining operations licence in the district hence creating a gap for local authorities to effectively monitor such operations efficiently.

v. Lack of Tools to Use in Monitoring Mining Environmental Issues

As mandated by the Public Health Act and the Local Government Act to monitor environmental issues and act on them as provided in the law. Lack of machinery to be used to monitor environmental issues such as air emission, water discharge and noise pollution and other environmental issues has continued to be a challenge.

This is clearly shown in Figure 4.8 where lack of tools for monitoring mining environmental issues was ranked 1st at 70%. This factor can also be linked to lack of resources to facilitate environmental management programs which was ranked 3rd at 55% as this requires a lot of resources to educate all stakeholders on environmental management strategies. Therefore, when all stakeholders are aware of the negative impacts of mining, mining developers will become responsible for their operations. Lack of engagement during licence period was ranked 2rd at 58%. Lack of human resource, collaboration and knowledge in sustainable mining was ranked 4th, 5th and 6th at 54%, 52% and 42% respectively.

vi. CSR has blinded Local Authorities from Monitoring Mining Environmental Issues

CSR projects are supposed to fulfil *capital's basic principles* and *environmental standards.* Judging from the list of CSR projects as presented in Figure 4.9, it clearly shows that these projects are capital in nature and facilitates social development as well as environmental wellness.

Support of agriculture programs through conservation farming are not just meant to make a specific land productive, it also supports micro biodiversity which is the sole purpose of making the environment safe and health for all living organisms. Provision of adequate clean water and sanitation provides a platform that supports life under water.

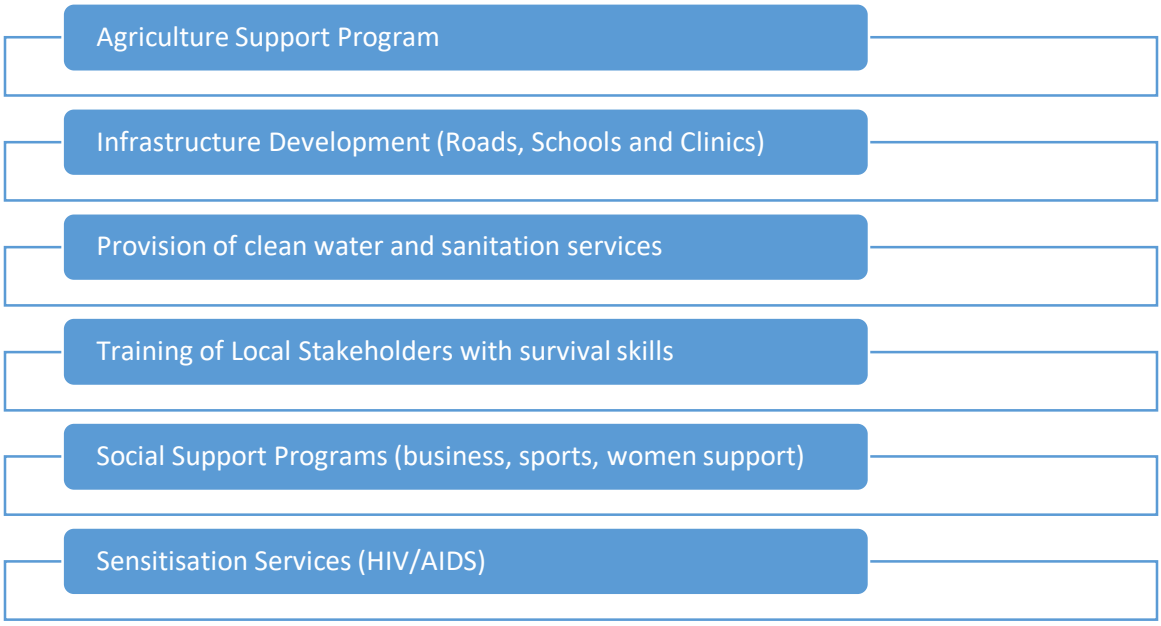

Figure 4.9: List of CSR projects undertaken by Kansashi Plc, Kalumbila Plc and Lumwani Plc in Solwezi and Kalumbila districts

Infrastructure development and sensitization services does not only improve people's access information and public facilities such as schools, hospitals / clinics and recreation to enhance social development but combined with training of communities with survival skills coupled with road development supports economic development and in the long run helps alleviate poverty and improves community lives.

The list of projects shown in Figure 4.9 are also some of major services provided by Kalumbila and Solwezi Councils. These CSR projects are then perceived to blind Solwezi and Kalumbila councils attention to manage pollution control related activities to instead partnering with the mining houses in attainment these projects.

4.4 Gaps and weaknesses in ZEMA's Environmental Management Strategies and there Appropriate Response through the EAT

The following findings, gaps and weaknesses were established regarding ZEMA's environmental management strategy and their appropriate response through the EAT as detailed in Table 4.2 below.

Table 4.2: Findings, gaps and weaknesses in environmental management strategy and their appropriate response through the EAT

No.	Findings, Gaps & Weakness ZEMA's Environmental Management Strategy	An Appropriate Response through the EAT
1.	Review of the Environmental Management Act and its supporting regulations ascertained that Zambia through ZEMA has put in place adequate regulations to safeguard human welfare and the environment through effective environmental management systems such as; air, water and noise pollution control, waste management, pesticide and toxic substances management and environmental impact assessment. Additionally ZEMA has a unit that deals with climate change related programmes while another unit deals in research to ensure effective handling of environmental dynamics.	Emphasizes strongly on strategic engagement of all conservancy authorities and key stakeholders involved in environmental management, protections, monitoring and compliance.
2.	Environmental issues are cross cutting hence the need for ZEMA to strategically engage all key stakeholders to champion environmental stewardship but this has been affected by lack of coordination and timely communication failure between conservancy authority stakeholders and ZEMA as shown in Appendix 5.	The EAT provides a platform that ensures that all spheres of government mandated with environmental management issues should align their functions and responsibilities and ensure that their policies, strategies, plans and programs are clearly streamlined for the purpose of working together in the spirit of mutual cooperation and safeguard human health and the environment.

		Adoption of the EAT will ensure that continuous engagements between LA and ZEMA to overcome communication failures and improve coordination between the two institutions. This will results into a well - integrated coordinated environmental management system between district local level and ZEMA at provincial level.
3.	The two main major gaps observed were lack of ZEMA's extension officers in all the 116 districts of Zambia and also to a large extent lack of manpower and technical capacity. This has limited ZEMA's responsibility to witness and appreciate how bi–annual statutory returns sampling are done on site and have hands on experience with the equipment being used but rather depend on the developers submissions. Are these bi – annual returns submitted by the developer the true reflection of what goes on the ground?	Adoption of an EAT tool will provide a platform for ZEMA to utilise engineers and Environmental Health Practitioners from LA to do extension works at district level. This will entail that ZEMA will be able to cover the entire 116 districts of Zambia in monitoring environmental issues and compliance on daily basis. The use of EAT will provide an advantage in environmental monitoring and compliance due to the established Ward Development Committees which is basically living around these mining houses. WDC working together with LA and ZEMA can devise a system to ensure effective environmental monitoring and compliance and ensure the mining developers take responsibility of the environmental actions.
4.	Lack of supervision towards the industry after projects have been authorized and pertained all its licenses and permits.	This to a large extended is attributed to inadequate human resource at ZEMA but as already stated above, EAT provided a platform for LA and ZEMA to combine human resource to provide technical supervision and support during licence period.
5.	Democracy, regulation and rule of law are an aspect of the Environmental Management that is hard to quantify as well as its impact on ZEMA's democracy, its capacity and willingness to regulate	This to a large extent is attributed to a political will. The EAT provide platform for engagement of civic leaders at local level with the view that when these leaders are aware and well informed of the adverse

	environmental activities and respect for the law. Findings reviewed that several highly profiled individuals, their relatives and associates are involved in mining. This makes it a high career risk activity for ZEMA officials of any rank to act against offenders. There are still a number of mines operating without compliance and hence they face no consequences for it. Mining has continued to receive political protection and this has made regulation impotent to a point where developers have become answerable to political offices as supposed to the ZEMA and other conservancy authorities as per the laws of Zambia.	effect of mining environmental issues they may become responsible in decision making both at local and national level regarding activities to do with the environment. .

4.5 The Local Authorities Proposed Environmental Audit Tool (EAT)

Figure 4.10 shows the graphical presentation of the Environmental Audit Tool (EAT). The EAT draws its strength from the constitution of Zambia, the environmental management act and its supporting regulations, statutory acts from conservancy authorities and policies such as the national decentralization policy. The EAT is limited to environmental impacts related to water, air and noise pollution, land degradation and hazardous waste. It also provides the statutory environmental compliance emissions and discharge limits for the reference of local and conservancy authorities. For monitoring, in addition to the mandated environmental monitoring by ZEMA, LA, Ministry of Mines and Mineral Development, other conservancy authorities and NGO's, EAT is meant to provides monitoring of environmental impacts by the wide public consisting of zonal representatives reporting to WDC who then reports to local authorities for action/punitive act. If the impact is beyond the mandate of local authority then it reports to ZEMA for further action or punitive act. Such a mechanism will provide a platform for environmental monitoring that covers the entire 116 districts in Zambia and devise an appropriate response to some of the gaps and weaknesses identified in Section 4.4 in the environmental management strategy.

To enhance its efficiency, the EAT has defined principles that govern its reporting system and other core values such as EAT approach based on impact and mitigation, assurance service, consultancy service, timing and corrective measures, external relations, timely EAT review and update. It is also meant to provide quality control by utilizing qualified experts from Local authorities. Figure 4.10 shows the detailed structure of the audit tool.

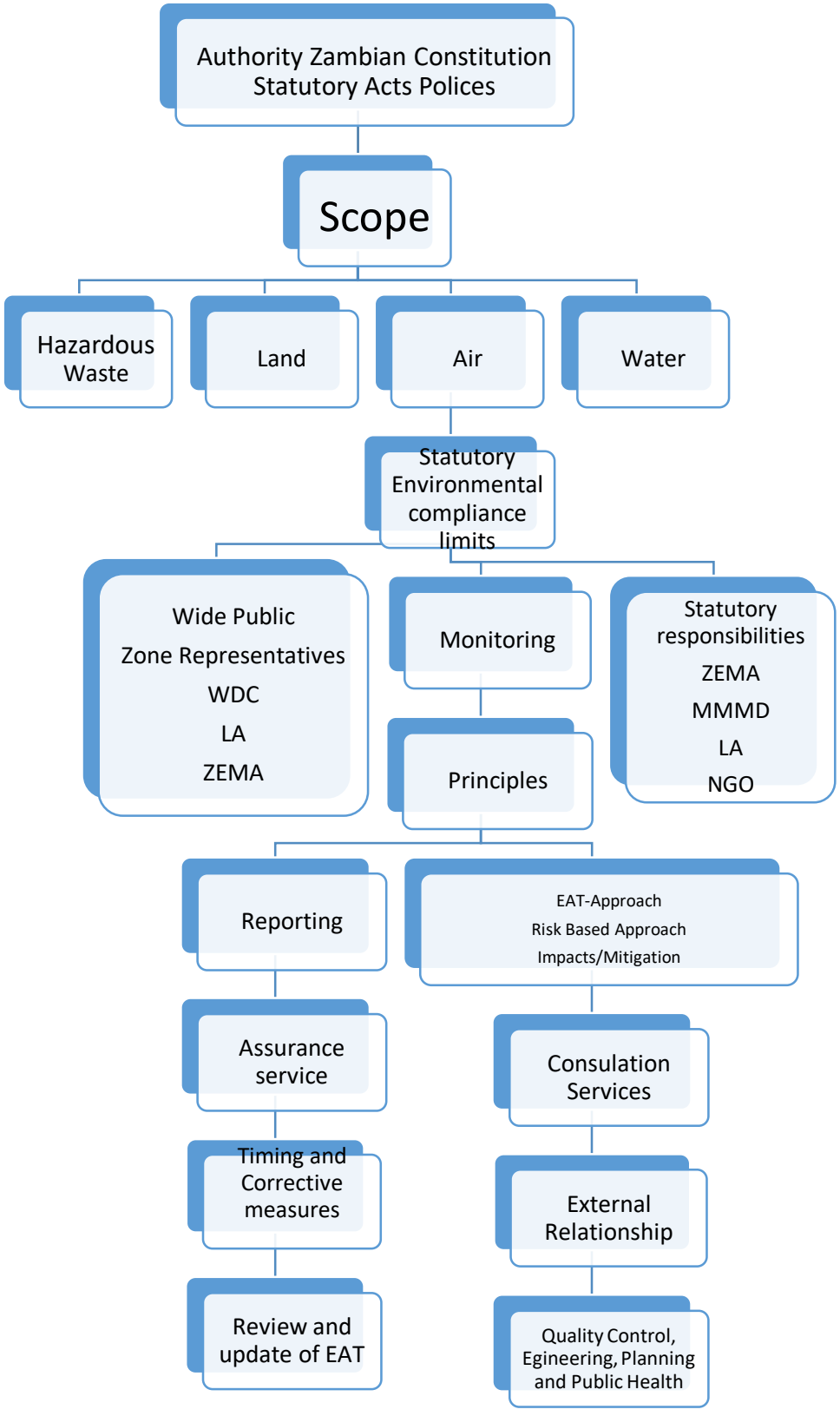

Figure 4.10: The proposed Environmental Audit Tool (EAT) for LA

4.5.1 Detailed Proposed Environmental Audit Tool Background

The Environmental Audit Tool (EAT) is a formal proposal document making reference from the Environmental Management Act, the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997, the Environmental Management (Licensing) Regulations, 2013; the Environmental Management (Extended Producer Responsibility) Regulations, 2018, the Local Government Act, the National Decentralization Policy, the Solid Waste Regulation and Management Act, 2018, the Public Health Act, the Urban and Regional Planning Act while supported by the Constitution of Zambia. It defines a systematic, documented, periodic and objective evaluation of how well District Councils working together with ZEMA and other conservancy authorities can safeguard human health and that of the environment. It establishes a scope, checklist and a set of environmental principles for stakeholders and conservancy authorities to manage environmental conditions governing air, water, land and noise pollution control, waste and hazardous waste management. This helps District Councils to monitor environmental issues as provided in the Local Government Act, 2019, Part III Section 16 and 17.

Environmental issues are cross cutting among a variety of sectors and hence the need for an integrated environmental management kind of approach. The main purpose of the Environmental Audit Tool is to provide such a platform for an independent, objective assurance and integrated environmental management system that engages Local Authorities (district councils) and their established WDC, ZEMA and other stakeholders to strengthen environmental monitoring and compliance to safeguard human health and the environment. The proposed EAT for Local authorities is meant to strengthen legislation and policies in monitoring mining environmental issues by LA through collaboration with ZEMA, Ministry of Mines and Mineral Development, NGO's and other conservancy authority as well as through the help of established WDC, zonal representatives and mining surrounding communities. It is the aim of the EAT that once the adverse effect of unsustainable mining which causes a lot of environmental issues are known across all key stakeholders, then the practice will be stopped. This will help provide a sustainable environment that support diversity life both on land and under water and also support a productive environment. The EAT differs from the existing environmental management strategy were ZEMA just engage the community during the EIA process but the EAT provide for continuous monitoring of mining

operations throughout its lifespan through the use of the LA and established WDC/zonal representatives and surrounding communities. The enhanced features of the proposed EAT is the fact that it supports the engagement of local authorities, zonal representatives and surrounding communities to continuously monitor mining environmental issues for action or onwards transmission and reporting to other conservancy authorities for further action as opposed to the current occupancy were ZEMA has to depend on well-wishers to report such environmental issues. The EAT has established a reporting system consisting of the following structures; the community where mining operations takes place report to their zonal representatives who in turn reports to the WDC for onwards transmission to LA authorities. Apart from these routes, LA will also conduct independent monitoring through their health inspectors / planners and engineers. According to the Local Government Act, Public Health Act and the National Decentralization Policy, LA are guided on issues to act on and any issues beyond their mandate are reported to ZEMA through the Operations Department and inspectors for action or punitive act. Figure 4.11 show the reporting flow chart mechanism.

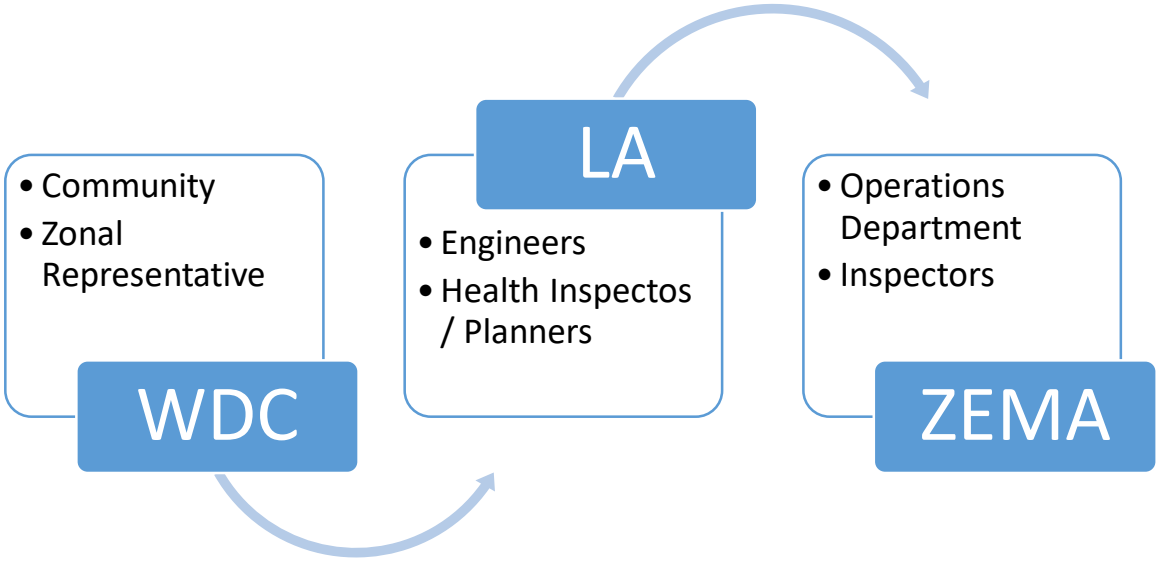

Figure 4.11: Mining environmental issues monitoring reporting flow mechanisms

The EAT is not meant to discourage investors but to instill a sense of responsibility for their actions as it supports the three tiers of sustainable growth through social-economic development

through creation of a productive, health and safe environment. It is also meant to provide an appropriate response to the established gaps and weakness stated in Section 4.4 above.

4.5.2 Scope

The scope of the EAT is limited to copper mines only but it may be extended to cover other industries upon advice from ZEMA and developers. The EAT is meant to help district councils monitor any activity or phenomenon to enhance environmental monitoring and compliance. The tool is focused on local authorities that are housing mines in their respective jurisdictions.
Despite mining having many environmental issues, the EAT only focuses on environmental impacts with mostly local and regional effects and those that have direct or indirect impacts on local communities and district councils service provision such as;

- Water, air and noise pollution
- Land degradation
- Waste
- And hazardous waste Management

4.5.3 Statutory Environmental Compliance Discharge Limits

Details on the water, air, noise and waste management disposal limits are shown in Appendix 7

4.5.4 Responsibility

Subject to the Environmental Management Act and its supporting regulations, the Local Government Act and Public Health Act, local authorities have the responsibility as the "conservancy authority" to manage, conserve, preserve, maintain or protect the environment from air, water, noise and land pollution as they control an undertaking, service or facility and prohibit use of it by the public or any class of the public.

It shall be the duty of the district council to join with the government, conservancy authorities, private partners, or any other person or authority and the Agency like ZEMA in areas to deal with environmental management so as to establishing and maintaining the undertaking, service or facility within their jurisdictions to comply with prescribed environmental laws and regulations.

The work regarding environmental monitoring and compliance shall be carried out by qualified officers from LA appointed by ZEMA as honorary inspectors and other relevant authorities using established laws and local government's procedures.

It shall be the responsibility of the local authority to take punitive action for any contravention of environmental related issues that falls within their mandate or engage ZEMA for suiTable action for cases outside their mandate.

It shall be the responsibility of the Local Authority to ensure that the up to date records of all environmental compliance report as stipulated by the Environmental Management (Licensing) Regulations of 2013 are reported to the subcommittee that deals with environmental related issues as well as keeping the Committee informed of emerging trends and successful practices in environmental management.

The local authority through the Public Health, Planning and Engineering Department will be responsible for conducting and planning for/an Annual Environmental Audit (AEA), using a safe procedure for identifying and monitoring environmental issues outlined above after approval from the Controlling Officer / Management and Acceptance by Environmental related Subcommittee / Council.

ZEMA working together with local authority shall maintaining officers, partners and supporting committees such as WDC with sufficient knowledge, skills, and experience in environmental related activities and capacity building to manage the dynamics of environmental issues.

Evaluating and assess significant merging / consolidating functions and new or changing services, processes, operations, and control processes coincident with their development, implementation, and / or expansion.

Assist in the investigation of significant suspected environmental contravention activities within its jurisdiction and notify management, Environmental Committee or ZEMA of the results for punitive action.

4.5.5 Relevant Legislation Supporting the Local Authorities

The Local Government Act provides for the establishment of Councils in districts, the functions of local authorities and the local government system. Some of the functions relate to pollution control and protection of the environment in general. Councils are spread throughout Zambia and this provides a very reliable platform to promote environmental management and ensure environmental compliance through collaboration with ZEMA.

The Urban and Regional Planning Act No. 3, 2015 provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land.

The Public Health Act, Cap 295 of the Laws of Zambia provides for the prevention and suppression of diseases and general regulation of all matters connected with public health in the country such as drainage, waste disposal and treatment of sewage. This is supported by **the Occupational Health and Safety Act of 2010** which provides for the health, safety and welfare of persons at work.

The Environmental Management Act No 12 of 2011 (amended as Act No. 10 of 2013) is an umbrella and principal law which stands over all other environmental legislation in Zambia. The Act which was renamed from the Environmental Council of Zambia to Zambia Environmental Management Agency (ZEMA) which now is mandated to ensure the sustainable management of natural resources and protection of the environment to provide for the health and welfare of people, animals, plants and the environment in general. Subject to this act, local authorities being conservancy authorities, mandates and promotes communities and relevant stakeholder engagement in environmental management.

4.5.6 Community Participation in Local Governance and Development

Local Authority shall ensure communities participate through WDC in environmental monitoring and compliance with the view to achieve the following; support sustainable development, sustainable mining, communities enjoy and appreciate the benefits, communities own the development processes and accept development messages and adopt new ideas.

The quality of participation in environmental monitoring and compliance will be accessed through a number of attributes with the following characteristics:

1. **Inclusiveness –** ensure that beneficiaries participate in environmental monitoring and compliance without feeling distanced from the project and policy makers.
2. **Willingness -** communities participate in the planning process without feeling coerced, constrained or left with no other choice.
3. **Comprehensiveness -** All key stakeholders participate in the planning process.
4. **Accountability and transparency –** ensure that developers or development facilitators are procedurally accounTable to the beneficiaries; and the planning and implementation process is also publicly visible.

i. Ward Development Committees (WDCs)

Local authorities should utilize established WDCs as mandated by the Local Government Act to enhance community participation in environmental monitoring and compliance with the understanding that Development can only be sustained if the beneficiaries of the development are meaningfully involved in order that: government and developers becomes more responsive to local needs. Community participation in environmental monitoring and compliance is assured process making conduct of public affairs more visible and government and developers more transparent. Encouraging such an integrated environmental management approach will make communities become more capable of managing their own lives and improved service delivery that is flexible and more likely to be directly relevant.

The WDC therefore, will be based on the rationale that environmental stewardship can better be sustained if managed in a decentralized context – where all key stakeholders, both female and

male, and various interest groups, take part in activities from the planning, implementation and decision-making.

ii. Composition of Ward Development Committees

Section 36 of the Local Government Act No. 2 of 2019 provides for the establishment in each ward of a Ward Development Committee in the area of a local authority consisting of the following part time members appointed by the Town Clerk or Council Secretary:

a. an elected zonal representative from each zone;
b. an extension officer from the department responsible for agriculture ,fisheries and livestock or economic sectors appointed based on the economic activity predominant in the ward as determined by the local authority;
c. an extension officer from the department responsible for education;
d. an extension officer from the department responsible for health;
e. an extension officer from the department responsible for community development;
f. a representative from a local nongovernmental organisation in a ward;
g. a representative of the Zambia Agency for Persons with Disabilities;
h. a representative from a marginalised group;
i. a representative of the Chief in the ward;
j. Ward Councillor;
k. a trustee from the local authority;
l. a youth,
m. sports and recreation focal point person;
n. and (m) a gender focal point person.

The members under subSection (1) (b), (c), (d) (e), (k), (l) and (m) shall be appointed as ex-officio members. The members under subSection (1) (b), (e), (f), (g), (h), (i), (j) and (l) shall be nominated by their respective institutions or organisations .The term of office for WDC members is five (05) years.

iii. Roles of WDCs

The main roles of WDCs are outlined below:

- Link between communities, the council and external development agents
- Mechanism enabling communities to access development information and knowledge
- Means of disseminating community needs, potentials and capacities
- Forum for mobilization of communities for common development efforts
- Forum for democratic involvement of communities in the development process.

iv. Functions of the WDC's

There are a lot of functions of WDCs as described under Section 37 of the Local Government Act which can be summarised into these three main functions; development planning and coordination resource mobilization and Monitoring and Evaluation.

v. Executive Committee

Section 38 of the Local Government Act No. 2 of 2019 gives the composition of established a Ward Development Executive Committee. The committee shall elected from among the Members of the Ward Development Committee consisting of the following part time members:

a. a Chairperson, who shall be elected from among the elected members from zones;
b. the Vice Chairperson who shall be elected by the members from among themselves;
c. secretary;
d. treasurer;
e. And four committee members. A Ward Development Executive Committee shall perform the executive functions of a Ward Development Committee.

4.5.7 Reporting

To enhance Environmental Management at Local Authorities level, the engineering, planning and public and health department shall report for administrative and legislative action to the controlling officer and the standing committee. Further, the departments under question and developers shall report legislatively to the environmental committee while adhering to the conditions provided in the licence conditions from ZEMA.

i. Reports

The engineering, planning, public health department and the developer shall submit the following reports to the controlling officer and the subcommittee in charge of environmental activities and while adhering to the conditions provided in the licence conditions from ZEMA.

i. Environmental impacts and there mitigation measures
ii. Quarterly environmental compliance returns sampled every month
iii. Developers Annual Environmental Plan

4.5.8 Environmental Audit Tool Approach

The environmental audit tool follows a risk based audit approach which places emphasis on the identification of environmental impacts of any project, there mitigation measures and evaluating of the annual environmental management plan as controls put in place to manage key related risks down to statutory acceptable levels. The audit approach combines two types of audit engagements, i.e. assurance and consulting (advisory) services.

4.5.9 Assurance Services

An objective examination of protection, conservation and sustainable use of various elements of the environment by local authorities will include project performance and compliance. These services refer to the evaluation of the adequacy, effectiveness and efficiency of the local authorities' environment monitoring and compliance control systems. Communities and stakeholder's engagements such as ZEMA and conservancy authorities among others will provide reasonable assurance that these environmental management processes are functioning as intended and will enable local authorities to achieve its goals and objectives, as well as provide recommendations in consultation with management or relevant authorities on how to improve its operations. The nature of the engagement will be guided as stipulated in the Local Government Act and the Environmental Management Act and supported by the Environmental audit Tool Work Plan.

4.5.10 Consulting Services

Advisory and related service activities, the nature and scope of which covers consulting from ZEMA or institutions who's, either voluntarily or under the authority of any law, manages, conserves, preserves, maintains or protects the environment is intended to add value and improve the local authorities environmental monitoring and compliance. The following categories of consulting engagements could be performed:

- Formal consulting engagement-planned and subject to written agreement.
- Informal consulting engagement-routine activities such as participating in standing committees, projects life cycle and routine information exchange.
- Special consulting engagement-participation in a capacity building on Environmental Management and Compliancy
- Emergency consulting engagement-participating in an advisory role on a developmental agenda to meet a special request or tight deadline.

The officer in charge should however maintain objectivity when drawing conclusions and offering advice to management, committee or ZEMA.

4.5.11 Timing and Corrective Measures

Where a critical environmental issue is identified, the local authority shall serve the developer on the environmental issues for immediate course of mitigation action. If considered necessary, the matter will be brought to the attention of the Controlling Officer and ZEMA.

In a case of a non-compliancy from the developer, the local authority shall take such procedures as stipulated in the Local Government Act, Public Health Act or any other environmental related regulations.

4.5.12 External Relationship

Environmental Audit Tool supports Strategic Social Partnership Engagement (SSPE) as key to creating a more "meaningful existence and sustainable planet". Decentralizing environmental management and compliancy will help Local Authorities and ZEMA to work together for this common noble goal. Local Authorities departments in charge of environmental related issues, ZEMA and other conservancy authority should have regular contact in order to maximize the benefits that council receives from the combined assurance process.

4.5.13 Review and update of the Environmental Audit Tool

The Environmental Audit Tool will be reviewed annually by the Local Authorities Internal Audit Unit and Tabled at the 1st quarterly meeting of the subcommittee responsible for Environmental related activities.

4.5.14 Quality control of the Engineering, Planning and Public and Health Department

The Department's responsible for environmental related activities performance will also be evaluated annually by the Controlling Officer and Audit Committee members and were necessary engage ZEMA.

4.6 Plan for the implementation of an Environmental Audit Tool

Table 4.3 shows proposed plan for the establishment of an EAT.

Table 4.3: Establishment of an EAT

S/N	ACTIVITY	OFFICER or INSTITUTION RESPONSIBLE
1	Orientation Workshop for Kalumbila, Solwezi District Councils and ZEMA on EAT	Researcher
2	Forward of the EAT to mining houses for comment	Researcher /ZEMA
3	Forward for EAT to Ministry of Local Government (MLG) for guidance	Kalumbila and Solwezi District Councils and ZEMA
4	Orientations Workshop for Councilors	ZEMA, Kalumbila and Solwezi District Councils and the researcher
5	Orientation Workshop for WDC's	ZEMA, Kalumbila and Solwezi District Councils and the researcher
6	Presentation to Sub committees for adoption	Kalumbila and Solwezi District Councils
7	Approval by Full Council	Kalumbila and Solwezi Districts Councils
8	Implementation of EAT	ZEMA, Kalumbila and Solwezi District Councils
9	Monitoring and Evaluation	Researcher, ZEMA, Kalumbila and Solwezi District Councils and the researcher
10	Roll over to other mining districts	Researcher, ZEMA, Kalumbila and Solwezi District Councils.

Chapter 5

Conclusions and Recommendations

5.0 Conclusion

For sustainable mining to be achieved, there is need to ensure that the ordinary citizens are given an opportunity to participate in the planning, implementation, monitoring and evaluation of interventions meant to improve their well-being and of their surrounding environment. Its only through such that everyone is guaranteed of an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that; prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. Therefore, implementing an integrated environmental management approach through stakeholder's engagement is key to creating a more "meaningful existence and sustainable planet". In line with the above:

1. The study has identified factors that contribute to weak monitoring of mining environmental issues by Local Authorities as:
   i. Lack of collaboration between Local Authorities, ZEMA and Conservancy Authorities;
   ii. Lack of Knowledge in Sustainable mining and mineral development;
   iii. Lack of Human Resource;
   iv. Lack of Local Authoroites engagement during mining licence period
   v. CSR has blinded Local Authorities from monitoring mining environmental issues and
   vi. Lack of tools to use in monitoring environmental issues.
2. Results of study indicate that mining environmental issues are cross cutting among a variety of sectors and hence the need for integrated environmental management approach. Engagement of local authorities in environmental management is one way of ensuring efficiency as creation of a safe and healthy environment starts locally. Therefore this study has proposed the EAT to effectively deal with environmental issues. As supported by Zambian legislations, WDC should

work very closely with the community/zonal representatives in monitoring mining environmental issues and always provide a report for the attention of the local authorities for action for environmental issues that falls within their jurisdiction or onward transmission to ZEMA on environmental issues that fall outside their mandate.

Previously Local Authorities and communities were only consulted at the inception of every developmental project and never involved during the license period. Therefore, Local authority/community should continually be told about the company's plan, conditions governing their licence and inviting them to modify them. Community involvement will promote accountability and transparency in utilization of resources as well as safeguarding human health and the environment. This is also supported by the Constitution of Zambia (Amendment) Act No. 2 of 2016 and provides for the establishment of a platform through which the citizens of Zambia will participate in planning, monitoring and evaluation of development initiatives in their areas.

Two major reasons for the justifications of establishment of WDCs are to improve the living standards of its people through community participation in development processes and address issues of escalating poverty levels which is linked to environmental health and its wellness. Poverty has merely been caused by exposure to worst environmental health and risks.

5.1 Recommendations

i. In view of the findings, gaps and weaknesses identified in Section 4.4 above, the following recommendations are hereby made: Under public consultation as provided for in The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997, Part II, Regulation No. 10, ZEMA must consider engaging public consultation and participation through the use of established Ward Development Committees under local authorities as provided in the Local Government Act No. 2 of 2019, Part V, and Section 36. This is also supported by the Constitution of Zambia (Amendment) Act No. 2 of 2016 and the National Decentralization Policy which provides for the establishment of a platform through which the citizens of Zambia will participate in planning, monitoring and evaluation of development initiatives in their areas.

ii. Subject to the Section 17, Part II of the Environmental Management Act No. 10 of 2013, ZEMA must collaborate and consider appointing honorary inspectors from Local Authorities so as to ensure they cover all the 116 districts of Zambia and overcome lack of human resource and technical capacity in supervising monthly bi–annual statutory returns sampling and testing and other environmental services. Further, ZEMA must include Local Authorities human resource in capacity building related programmes so as to enhance Environmental Management and compliance.

iii. ZEMA must **direct** developers to apart from submission of bi – annual returns twice to the agency, also submit and engage local authorities in monthly sampling and test report meant for their bi – annual statutory returns for verification purposes. Developers should further be directed to report returns to the Local Authorities quarterly Committee meetings as proposed in Section 4.5 under the Environmental Audit Tool above to enhance environmental pollution control and compliance.

5.2 Suggestions for further work

The outcomes of the research has raised the prospect of further research. The following are the likely avenues worth investigating:

- Investigating the quality of input of Conservancy Authorities and Communities through public hearing prior to mining project licencing
- Identification of loop holes in the current environmental management strategy from all conservancy authorities and devising an appropriate response.
- Investigate the authenticity of mining BI returns to ZEMA and their effect on environmental compliance.

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Appendix 1

Informed Concert

Title: Establish factors that has led to weak monitoring of environmental aspect of mining by Local Authorities in Zambia; A case study of North-Western Province.

Concert to take part in research

- I .....voluntarily agree to participate in this research study
- I understand that even if I agree participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that i can withdraw permission to use data from my interview within two weeks after the interview or answering the questionnaire in which case the material will be deleted
- I have had the purpose and nature of the study explained to me by the researcher and I have had opportunities to ask questions about the study
- I understand that participation involves: being interviewed by the researcher using a an interview guide or answering the questionnaire.
- I understand that I will not benefit directly from participating in this research
- I understand that all information I provide in for this study will be treated confidentially
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview/questionnaires which may review my identity or the identity of the people I speak about
- I understand that disguised extracts from my interview may be quoted in the researcher's final thesis for the purpose of this study.

Appendix 2

Questionnaire / Interview Guide

Questionnaire Identity…….

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

CIVIL AND ENVIRONMENTAL ENGINEERING DEPARTMENT

Hello,I am Festus Mukuka Kakana, a post graduate student in the School of Mines, Department of Metallurgy and Mineral processing at the University of Zambia.

I am conducting a research in Master of Mineral Science, degree in Sustainable Mineral Resource Development on establishing factor that have led to weak monitoring of mining environmental issues by local authorities, a case study of Kalumbila and Solwezi Local Authorities.

Your participation in this study is entirely voluntary and important as it will help me fulfill part of the requirement for obtaining my Master's degree in the school of mines.

I however hope that you will be willing to participate fully as your information will help me establish factors that have hindered local authorities to monitor mining environmental issues and design an audit tool that maybe adopted in environmental management in Zambia. You are also assured that the information you shall provide by way of answering questions in this questionnaire will be treated confidentially and only for the purpose of this study. Your cooperation will be appreciated.

No.	Questions		Tick [√] your answer			
1.	To what extent do the following factors define sustainable development / sustainable mining?	1. Economic development 2. Social equity 3. Environmental wellness	1	**Major**	**Medium**	**Minor**
			2			
			3			
2	To what extent does mining influence the following developmental agendas	Infrastructure and housing development	1			
		Energy production	2			
		Technological advancement	3			
		Food production	4			
		Employment opportunities	5			
		Poverty alleviation	6			
		Improve access to education and health	7			
		Improve community living standards	8			
		If not on the list above, please list below …….. …….. ……...				
3	To what extent does mining impose the following negative impacts in the district / municiple	Air pollution	1			
		Water pollution and saltation	2			
		Land degradation	3			
		Soil contamination	4			
		If not on the list above, please list below …….. …….. ……...				

4	What measures has the mining houses put in place to prevent mining environmental impacts?	Insert Air Emission Purification technology...……1 Monitoring boreholes……2 Engineered tailing dams and……..……..….3 Prevention formation of acid drainages……..……..……4 Not aware of any.....5 If not on the list above, please list below …… …… ……	[ ] [ ] [ ] [ ] [ ]
5.	What are the Roles of Local Authorities in Mining and Mineral development?	Domestic Waste Management……..……1 Revenue Collection……2 Approval of Plans…….……...……..….3 Pollution Control……..……..……..……4 Facilitate approval of Mining Project through ZEMA by comment.....5 If not on the list above, please list below …… …… ……	[ ] [ ] [ ] [ ] [ ]
6.	What professionals do Local authorities use to monitor environmental issues?	Environmental Health…….……1 Civil and Environmental Engineers……..……2 Chemical Engineers……...3 Geologist……..……...……..….4 Metallurgists…….……5 Mining Engineers……...……6 Technicians……..……...……..….7 If not on the list, please list below …… ……	[ ] [ ] [ ] [ ] [ ] [ ] [ ]

		……	
7.	To what extent should government institution such as ZEMA, Ministry of Mines and Mineral Development, Local Authorities and others Ministries collaborate to enhance sustainable environmental management?	<table><tr><th>Major</th><th>Medium</th><th>Minor</th></tr><tr><td></td><td></td><td></td></tr></table>	
5.	What are some of the CSR projects undertaken in your district / municipals?	1…… 2…… 3…… 4……	
6.	To what extent do the following factors hinder Local Authorities in monitoring mining environmental issues that have negative impacts on their service provision as mandated by the Local Government Act?	Lack of collaboration between GRZ instituteseg (ZEMA)……...1 Lack of knowledge in sustainable mining and mineral development….2 Lack of human resources in mining environmental related issues…...….3 Lack of tools requiredto use in mining environmental issues……...4 Lack of engagement during/post mining related issues……..…….5 Lack of resources to facilitate environmental management programs…….6 If not on the list above, please list below …….. …….. ……...	<table><tr><th>No.</th><th>Major</th><th>Medium</th><th>Minor</th></tr><tr><td>1.</td><td></td><td></td><td></td></tr><tr><td>2.</td><td></td><td></td><td></td></tr><tr><td>3.</td><td></td><td></td><td></td></tr><tr><td>4.</td><td></td><td></td><td></td></tr><tr><td>5.</td><td></td><td></td><td></td></tr><tr><td>6.</td><td></td><td></td><td></td></tr></table>

7.	Is there anything else you would like to mention about how Zambia can enhance environmental management?	…….....1 ……..……...……...2 ……..……...…..……3 …….…….…….….4 …….……...5 ……...……...……6	

THANK YOU FOR PARTICIPATING IN THE STUDY

INTERVIEW GUIDE FOR LOCAL AUTHORITIES, MINING HOUSES AND COMMUNITY REPRESENTATIVES

I am Festus Mukuka Kakana, a post graduate student in Master of Mineral Science, degree in Sustainable Mineral Resource Development. Am conducting a research on establishing factor that have led to weak monitoring of mining environmental issues by local authorities, a case study of Kalumbila and Solwezi Local Authorities. Voluntarily kindly answer these questions freely in this interview. The information you are going to provide will be purely for academic purpose and will be used as such, meaning confidentiality shall be exercised seriously. Your cooperation will be appreciated.

1. Sex of the respondent
2. How do you understand sustainable development and sustainable mining?
3. What are the benefits of mining to the community?
4. What are the negative impacts of mining to the community?
5. What measures has the mining houses put in place to prevent mining environmental impacts?
6. Which government institute monitors mining environmental compliance?
7. Which other government institute are engaged in monitoring mining environmental compliance?
8. What is the role of local authorities in mining?
9. What tools/Professionals do Local Authorities use to monitor environmental issues
10. What has hindered Local Authorities in monitoring mining environmental issues that have negative impacts on their service provision as mandated by the Local Government Act?
11. What activities under corporate social responsibility have been implemented by the mines?
12. Are these activities capital in nature and promote environmental wellness?
13. Is there anything else you would like to mention about how Zambia can enhance environmental management?

THANK YOU FOR PARTICIPATING IN THE STUDY

Appendix 3

Towards Sustainable Mining Principles

1. Involve stakeholders in the design and implementation of the TSM initiative; the first principles values the concept of an inclusive pathway that leaves no-one behind. Sustainable mining should include every stakeholder from community level through the local authorities to international bodies.
2. Proactively seek, engage and support dialogue with respect to the TSM initiative;
3. Foster leadership throughout companies participating in TSM to achieve **sustainable resource stewardship, whenever a member company operates**;
4. Conduct all company affairs with excellence, transparency and accountability:
5. Protect the **health and safety of company employs, contractors and communities**
6. Contribute to the global initiatives to promote **production, use and recycling of metals and minerals in a safe and environmentally responsible manner**
7. Seek to **minimize the impact** of TSM member company operations on **the environment and biodiversity** through all stages of development from exploration to closure;
8. Work with stakeholders to **address legacy** issues such as orphaned and abandoned mines;
9. Practice continuous improvement through the applications of new technology, innovation and best practices in all facets of TSM operations.

   In addition, all aspects of TSM member business and operations will:
10. **Respect human rights** and treat those with whom we deal, fairly and with dignity;
11. **Respect the cultures, customs and values**of the people with whom TSM members interact;
12. **Recognize and respect the unique role, contributions and concerns of aboriginal peoples**(First Nations, Inuit and Metis) and indigenous people worldwide;
13. Obtain and maintain business through ethical conduct;
14. Comply with all laws and regulations in each country where we operate and apply the standards reflecting our adherence to those guiding principles and **our adherence to best international practices**;
15. Support the capabilities of communities to participate in opportunities provided by new mining projects and existing operations;

16. Be **responsive to community priorities**, needs and interests through all stages of mining exploration, development, operations and closure;
17. Provide lasting benefits to local communities through self-sustaining programs to **enhance the economic, environment, social**, educational and health care standards they enjoy.

Appendix 4

Steps for the EIA and EPB assessment

Step 1: Preliminary actions

a. Setting up an environmental team with specialists.
b. Setting up the terms of reference for the study (needs approval from ZEMA).

Step 2: Scoping

a. Review all applicable laws, policies and international obligations.
b. Identify possible alternatives to the project layout.
c. Identify main impacts to determine which specialist studies are needed (should be decided after consultation with ZEMA).

Step 3: Baseline study

a. Detailed description of existing environment.

Step 4: Impact evaluation

a. Evaluation of predicted impacts for various situations.

Step 5: Public Participation

a. Hear the view of the affected community.

Step 6: Identification of mitigation measures

b. Measures for firstly elimination, and secondly reduction of environmental impacts.
c. Include noise control, treatment of effluent waters, air pollution control, waste control and other appropriate measures.
d. The cost of mitigation measures must be calculated and included in an Environmental Management Plan.

Step 7: Assessment of impacts and decision making by the developer

a. Comparison of all alternatives by the team. b. Ranking and recommendations by the team.
b. Decision by the developer for one alternative and an explanation for the rejection of other alternatives.

Step 8: Submission to ZEMA followed by a review process

a. From the day the EIS is submitted to ZEMA the process by law is not allowed to exceed 65 days.
b. ZEMA sends the application for submission of comment to sector institutions (e.g. Mines Safety Department, Department of Water Affairs and hosting Local Authority) that by law are enforced to reply within 30 days.
c. ZEMA shall place notifications in national newspapers and do everything possible to distribute the application to ministries, NGOs and affected parties who are allowed to leave written comments within 20 days after the notification in the newspaper.
d. ZEMA organizes a public consultation in the locality of the proposed project.
e. ZEMA reviews the application and makes a field visit to verify the content of the EIS.
f. ZEMA takes all aspects into consideration and writes a recommendation letter to the decision committee stating if the project should be rejected or approved and if so under which conditions.

Step 9: Decision making

a. A decision committee of five people drawn from the board of ZEMA takes the decision.
b. The committee communicates its decision through a decision letter which shall be distributed to all parties.
c. An approval letter often follows with specific conditions and it also binds the developer to fulfill what is stated under the Environmental Management Plan provided in the EIS.

Appendix 5

Environmental management none response from local authorities

Telephone: 250732/ 250528
Telegrams: LOC GOVT. LUSAKA
Fax: 252680
E-mail: ps@mlgh.gov.zm

In Reply please quote
MLG/20/1/2

REPUBLIC OF ZAMBIA
MINISTRY OF LOCAL GOVERNMENT

P.O. Box 50027
1501 RIDGEWAY
LUSAKA

17th April, 2019

All Provincial Planners

All Town Clerks and Council Secretaries
City, Municipality and Town Councils
REPUBLIC OF ZAMBIA

RE: ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY (ZEMA) CONCERNS OVER NONE RESPONSE FROM COUNCILS AND PLANNING AUTHORITIES

Refer to the subject captioned above.

I have received with concern information that very few Councils and Planning Authorities give feed back to ZEMA once it solicits for comments over proposed projects in your various areas. Subsequently, ZEMA is compelled to approve projects without input from the Council or Planning Authority.

This state of affairs is retrogressive as approvals may be granted to projects which otherwise would have been rejected had the Council submitted comments. I further note that all Councils have a position of Environmental Planner, who should take interest in such matters and yet most of Councils fail to respond to ZEMA.

With the foregoing, I wish to direct all Councils and Provincial Planning Authorities to ensure that you provide comments on all projects in your area once requested to do so by ZEMA.

By copy of this minute, ZEMA is requested to provide me with names of Councils that will, from now going forward, fail to provide comments on projects in their areas.

Amos Malupenga
Permanent Secretary
MINISTRY OF LOCAL GOVERNMENT

Cc: The Director General, ZEMA, **Lusaka**

Appendix 6

EIAMS Principle of Integration

1. The EIAMS entails the implementation, adaptation and/or reformulation of the Integrated Environmental Management (IEM) system currently being implemented by the National Environmental Management Act (NEMA), in order to integrate effectively environmental considerations into all aspects of governance.

2. The integration of environmental management principles into policies, plans, programmes, projects and processes is central to the implementation of the EIAMS.

3. A primary purpose of the EIAMS is to enable and enhance the utilization of a range of Environmental Management (EM) instruments and tools to achieve, among others, the following:
3.1. To integrate environmental considerations into the formulation and implementation of policies, plans, programmes and projects.

3.2. To inform environmental decision making at both strategic and project specific levels.

3.3. To ensure the development and use of appropriate EM instruments and tools (appropriate means relevant to the context), whether at a broad spatial scale, in a strategic application, or in a specific locale.

3.4. To ensure decision making that is based on and supported by the knowledge, information and values generated by or through the application of EM instruments and tools.

3.5. To attain the environmental right contained in the Constitution (RSA, 1996: Section 24(b)) which requires that the environment is protected *"through reasonable legislative and other*

measures that - … secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

3.6. To promote co-ordination, alignment and/or of regulatory processes and decision making to:
3.6.1. Improve and enhance the efficiency of decision making, and

3.6.2. Improve and enhance the efficacy of decision making in maintaining and enhancing the integrity of the environmental management mandate.
3.7. To ensure the use of EM instruments and tools that are 'fit for purpose'

3.8. To promote compliance and enable effective self-regulation through an adequately resourced compliance monitoring and enforcement programme.

4. For the purpose of determining the most appropriate EM instrument or tool (or combination thereof), 'fit for purpose' means that:
4.1. The EM instrument or tool is appropriate to the nature, scale and scope of a proposal or activity and the level of assessment and evaluation required to enable defensible environmental decision making (i.e. relevant and rational considerations).

4.2. The EM instrument or tool is appropriate to the significance of anticipated impacts of proposals or activities and the level of information required for defensible environmental decision making by providing for a scoped yet comprehensive analysis of potentially significant environmental effects.

4.3. The EM instrument or tool that will most effectively enable: the identification, prediction, assessment and evaluation of the potential and actual environmental impacts and the risks of proposals and activities; and will enable the consideration of alternatives and options for mitigation, with a view to minimising negative impacts, maximising benefits and promoting compliance with the national environmental management principles in Section 2 of NEMA.

4.4. The EM instrument or tool is undertaken at the appropriate level (i.e. strategic or project level).

4.5. The EM instrument or tool enables informed and impartial decision making by the relevant authorities.

Appendix 7

Licence Conditions

1. Emissions to Air

The permits to emit air pollutants relate to specific operations undertaken at a particular mine. In order to comply with the Environmental Management (Licensing) Regulations, 2013, mines need to confine to the following generic ZEMA Emissions Limits as tabulated in Table 1.

Table 1: Generic air emissions limits

Description	**Pollutant Concentration (mg/Nm3)**											
Emissions	Dust	CO	SO2	NOx	Cd	Cu	Pb	Hg	Acid mist	CO2	Co	As
ZEMA Limits	**0-50**	**0-175**	**0-1000**	**0-600**	**0.05**	**1.0**	**0.2**	**0.05**	**-**	**-**	**-**	**0.5**

2. Discharge of Effluent

2.1 Surface water

The permits to emit effluents from plant combined drainages and tailing dams to nearby streams or rivers should comply with the following Generic Physical, Biological, Chemical, and Metal ZEMA Limits detailed in Table 4. These parameters should be obtained at a temperature less than 40 ºC and color less than 20 Hazen Units as well as ensuring that the effluents does not cause any deterioration in odour as compared with natural state.

(i) Physical Parameters

No.	Parameter	Effluent and waste water limits into aquatic environment
1.	Turbidity (NTU scale)	≤ 15 Nephelometer turbidity units
2.	Total suspended solids(Gravimetric method)	≤ 100 mg/L must not cause formation of sludge or scum inreceiving water
3.	Settleable matter sedimentation in 2 hours (Imhofffunnel)	≤ 0.5 mg/L in two hours. Must not cause formation of sludgein receiving water
4.	Total Dissolved Solids (Evaporation @ 1050 C andGravimetric method)	≤ 3000 mg/L The TDS of waste water must not adverselyaffect surface water
5.	Conductivity (Electrometric method)	≤ 4300 mS/cm

(ii) Biological Parameters

No.	Parameter	Effluent and waste water limits in aquatic environment
1.	Total Coliform/100 ml (Membrane Filtrationmethod)	≤ 25000 cells
2.	Faecal Coliform/100ml (Membrane Filtration method)	≤5000 cells
3.	E. coli counts/100 ml	≤ 10 cells
4.	Algae /100 ml (Colony counter)	≤ 1000 cells

(iii) Chemical Parameters

No.	Parameters	Effluent and waste water limits in aquatic environment
1.	pH (0-14 scale) (Electro-metric method)	6.0 - 9.0
2.	Dissolved oxygen mg Oxygen/Litre (ModifiedWinkler method and membrane electrode method)	≤ 5 mg/L after complete mixing extreme temperature mayresult in lower values
3.	Chemical Oxygen Demand (COD) (Dichromatmethod)	COD based on the limiting values for organic carbon ≤ 90 mg02/L average for 24 hours
4.	Biochemical Oxygen Demand (BOD) (ModifiedWinkler method and Membrane Electrode method)	≤ 50 mg 02/L (mean value over 24 hours period) Accordingto circumstances in relation to the self-cleaning capacity ofwaters
5.	Nitrates (NO3 as nitrogen) (Spectrophotometric method and electrometric method)	The nitrates burden must be reduced as far as possible according to circumstances: water course ≤ 50 mg/L; Lakes 20 mg/L
6.	Nitrite (NO2 as nitrogen/L Spectrophotometric sulphanilamide)	≤ 2.0 mg NO2 as N/L
7.	Organic Nitrogen (Spectro-photometric method NKjeldal)	≤ 5.0 mg/L Mean* (* the % of nutrient elements for degradation of BOD should be 0.4 - 1 % forphosphorous (different forprocesses using algae)
8.	Ammonia and Ammonium (Total) (NH3 as N/L) (Nesslerization method and Electrometric method)	The burden of ammonium salts must be reduced to ≤ 10 mg/L (depending upon temperature, pH and salinity)

9.	Cyanides (Spectrophoto-metric method)	≤ 0.2 mg/L
10.	Phosphorous (Total) (PO4 as P/L) (Colori-metric method)	Treatment installation located in the catchment area of lakes: ≤ 1.0 mg/L; located outside the catchment area: reduce the load of P as low as possible (PO4 = 6 mg/L)
11.	Sulphates (Turbidimetric method)	≤ 1500 mg/L
12.	Sulfite (Iodometric method)	≤ 0.1 mg/L (presence of Oxygen changes SO3 to SO4)
13.	Sulphide (Iodometric and electrometric method)	≤ 0.1 mg/L (depending on temperature, pH and dissolved O2)
14.	Chlorides CI/L (Silver nitrate and Mercuric nitrate)	≤ 800 mg/L
15.	Active chloride Cl2/L (Iodometric method)	≤ 0.5 mg/L
16.	Active Bromine (Br2/L)	≤ 0.1 mg/L
17.	Fluorides F/L (Electro-metric method and Colorimetric method with distillation)	≤ 2.0 mg/L

(iv) Metals, Radioactive and Organics Impacts

No.	Parameters	Effluents and waste water limits in aquatic environment
1.	Arsenic (As) compounds (Atomic Absorption method)	d" 0.05 mg/L
2.	Cadmium (Cd) compounds (Atomic Absorption method)	d" 0.5 mg/L
3.	Cobalt (Co) compounds (Atomic Absorption method)	d" 1.0 mg/L
4.	Copper (Cu) compounds (Atomic Absorption method)	d" 1.5 mg/L
5.	Lead (Pb) compounds (Atomic Absorption method)	d" 0.5 mg/L
6.	Mercury (Hg) (Atomic Absorption method)	d" 0.002 mg/L
7.	Oils and grease (Mineral and Crude) (Chromatographicmethod and Gravimetric method)	d" 5.0 mg/L
8.	Uranium (Mass spectrometry or Laser photometry)	d" 0.03mg/L
9.	Any other radioactive materials	0

2.2 Ground Water

Ground water inspection boreholes should be used to monitor ground water quality. Boreholes should be reinforced and well protected to prevent chances of vandalism. Monitoring boreholes should be installed at all dump site and around mining Sections/area.

Inspection boreholes at dumping sites should be monitored monthly and district councils and other conservancy authorities should rehearse with ZEMA and the developer on the statutory effluents discharge limits allowable to infiltrate into the underground water aquifers. Faecal and Total coliforms among other dangerous parameters that are harmful to human health and biodiversity

should be limited to zero as most communities in Zambia depend on underground water for domestic use and livestock.

In collaboration with Water Resource Management Agency (WARMA), ZEMA, District Councils and other government Authorities and partners should consider introducing monitoring boreholes to be installed around mining Section area to monitor and maintain aquifer water flow rate so as not to disturb communities accessing underground water after the mining area. The developer should sink boreholes before the mining Section pump water out of the aquifer to prevent pollution and to disturb its flow rate and inject the water back into the aquifer after the mining area using the other boreholes after the mining Section. This will ensure that access to underground water from the disturbed aquifer has no effect on surrounding communities. This regulation has not been provided for in the Environmental Management (Licensing) Regulations statutory instrument. The Agency has sited cost associated with it to be one of the major reasons to why it has not been implemented yet.

3. Waste Management

As the Local Authorities, regulate, inspect, supervise and license the undertaking, service or facility within their jurisdiction and monitors monitor's environmental issues, the offices responsible should be aware of the following generic disposal site waste management conditions subject to prevention and control outbreak of dieses and air, water and land pollution:

1) The developer shall restrict access to the dumpsites to authorized personnel only.

2) The developer shall ensure that **hazard warning and safety signs** are displayed at appropriate places around the overburden dumps.

3) Disposal of waste **should be authorized / licensed by** the Zambia Environmental Management Agency (ZEMA) through established procedures.

4) The developer shall appoint a competent person to inspect the dump and its surrounding to ensure that:
   i) The drainage of the dump site is good;
   ii) The dump wall is stable;

iii) The dump has no tension cracks;
iv) Formation of gullies is controlled; and
v) Dumping of the waste is supervised if the dump is active.

5) The competent person referred to in (4) above shall record all non-compliances and the developer shall take necessary measures to correct the non-compliances.

6) The developer shall drill monitoring wells at appropriate sites around the dump sites for monitoring of surface and ground water contamination against the parameters described under emissions of effluents.

7) The developer shall ensure that ground water samples from monitoring wells are taken weekly for analysis.

8) The developer shall conduct progressive rehabilitation activities on the overburden dump throughout the licence period.

9) The developer shall ensure that the materials dumped is managed in such a way as to:
i) Ensure its stability and minimize risks to other adjacent land uses; and
ii) Avoid polluting surrounding areas including surface and ground water bodies.

10) The developer shall ensure that all personnel working at the dump site are provided with appropriate safety and protective wear together with first aid facilities and training.

11) The developer shall fully comply with all the Zambian regulations regarding waste management.

12) The developer shall ensure that a copy of the licence and conditions are distributed to all employees that shall be responsible for management of the overburden dump and ensure that all the licence conditions are understood by responsible officers.

13) The developer shall be invited to give a quarterly **compliance report** in the Local Authorities Subcommittee that deals with environmental management.

14) Local Authorities health inspectors **shall be allowed** at any reasonable time to inspect the dump site and check any documents relating to management of the dump site in order to determine compliance to these Licence conditions issued by **ZEMA**.

15) Contravention of any of the above conditions may prompt the local authority as a conservancy authority to recommend to ZEMA for revoke of Licence, prosecution or any other suitable action.

4. Hazardous waste

The different hazardous materials produced by the plant should be stored at certified licensed stored areas and disposed by a licensed vendor for recycling, reuse or safe disposal. The following conditions then should guide hazardous waste management.

1. Segregation shall be carried out by the trained workers or any other responsible person generating waste. This shall be done as close to the point of generation as possible.

2. Suitable Hazardous Waste receptacles of **appropriate size and number shall be readily available** at the point of generation, located away from populated areas to avoid accidents or emergencies.

3. The developer shall monitor the stored hazardous waste to prevent contamination of the environment and submit the results of the monitoring to the Local Authority as described above.

4. The developer shall comply with the requirements for storage of hazardous waste as prescribed by ZEMA

5. **Reusable waste containers shall be washed with a suitable disinfectant.**

6. The storage area shall be of appropriate specifications including:

a. An **impermeable** and **banded wall constructed** around it;
b. Adequate ventilation to avoid build up of hazardous fumes;
c. Limited **access to authorized** personnel only;
d. **Safety signs visibly displayed** at appropriate points.

7. All Hazardous Waste receptacles **shall be clearly labelled** with name of the type of waste and the source of the waste. This information may be written directly on the receptacle or on

pre-printed labels, securely attached. The basic information to be placed on receptacles shall be:

a) Waste type
b) Source of waste
c) Date and time of waste generation
d) Amount of waste generated

8. The personnel involved in the handling of the Hazardous Waste shall be provided with:

a) Adequate protective and safety clothing i.e. Heavy Duty PVC Gloves, Gum Boots, Gas Mufflers, etc.
b) Adequate and appropriate equipment or facilities for loading and off-loading waste.

9. Local Authorities Health Inspectors **shall have the right to inspect the Storage facilities at any reasonable time.**

16) Contravention of any of the above conditions may prompt the local authority as a conservancy authority to recommend to ZEMA for revoke of Licence, prosecution or any other suitable action.