Environmental and Social Impact Assessment Report for the Proposed Establishment of Mercury-Free Gold Processing Demonstration Centre for Artisanal and Small - Scale Gold Miners (ASGM) at Bumva Village Segese Ward, Msalala District in Shinyanga Region

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The University of Dar es Salaam wishes to acknowledge the collaborations from NEMC and the financial (the World Bank), the Msalala Local Government Authority, the Miners Association, and the Msalala Community in general for their contribution to the preparation of this ESIA report. UDSM also wishes to acknowledge the effort put in by the team of experts.
Thank you all!

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
ASGM	Artisanal and Small-Scale Gold Miners
ASM	Artisanal and Small-Scale Mining
BOD	Biochemical oxygen demand
CBA	Cost Benefit Analysis
COD	Chemical Oxygen Demand
DC	District Commissioner
DED	District Executive Director
EHPMP	Environmental Health and Pollution Management Project
EHSM	Environmental Health and Safety Manager
ELO	Environmental Liaison Officer
EMA	Environmental Management Act
Eng.	Engineer
EoI	Expression of Interest
ERB	Engineers Registration Board
ERP	Emergency Response Plan
ESF	Environment and Social Framework
ESIA	Environmental and Social Impacts Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
FEMATA	Federation of Miners Association of Tanzania
FM	Financial Management
FMS	Financial Management System
FY	Fiscal Year
GCLA	Government Chemist Laboratory Authority
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GPS	Global Positioning System
HIV	Human Immunodeficiency Virus
HSMP	Health and Safety Management Plan
IFC	International Finance Corporation
ISO	International Standards Organisation
LGA	Local Government Authority
LSM	Large Scale Mining
LTBWB	Lake Tanganyika Basin Water Board Office
MC	Mining Commission
MoM	Ministry of Minerals
MoU	Memorandum of Understanding
MoW	Ministry of Water and Irrigation
NEMC	National Environment Management Council
NEP	National Environmental Policy

NSGRP	National Strategy for Growth and Reduction of Poverty
PDO	Project Development Objectives
PIM	Project Implementation Manual
PIT	Project Implementation Team
PM	Project Manager
PMC	Project Management Consultant
PMU	Procurement Management Unit
PO-RALG	President's Office, Regional Administration and Local Government
PS	Permanent Secretary
QMS	Quality Management System
SIDO	Small Industries Development Organization
SMMRP	Sustainable Management of Mineral Resources Project
SoMG	School of Mines and Geosciences
SoMG	School of Mines and Geosciences
TAC	Technical Advisory Committee
TANESCO	Tanzania Electric Supply Company
TBS	Tanzania Bureau of Standard
TC	Technical Committee
TFS	Tanzania Forest Service Agency
TSF	Tailings Storage Facility
TZS	Tanzania Shilling
UDSM	University of Dar es Salaam
UNDB	United Nations Development Business
USD	United States Dollar
VPO	Vice President's Office
WB	World Bank
WWT	Waste Water Treatment

EXECUTIVE SUMMARY

Environmental Impact Assessment Report for the Proposed Establishment of Mercury-Free Gold Processing Demonstration Centre For Artisanal Small -Scale Gold Miners (ASGM) at Bumva Village Segese Ward, Msalala District in Shinyanga Region.

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INTRODUCTION

The Environmental Health and Pollution Management Project (EHPMP) is a five-year (July 2020–July 2025) Global Environmental Facility (GEF) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana. The World Bank conceptualized the project under funding from GEF. The EHPMP aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries. ASGM uses mercury in gold recovery in a manner that is dangerous to human health and the environment because amalgamation is done with bare hands and the amalgam is heated in open air to drive away the mercury. Furthermore, the available literature indicates that in ASGM for every 1 kg of gold recovered, about 2 kg of mercury is used and most of it is released into the environment (VPO, 2020). In response, the government, through EHPMP intend to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region, to pilot alternative technology.

The EHPMP project operated in seven regions of Shinyanga, Songwe, Mwanza, Mara, Geita, Singida and Mbeya. The EHPMP is packaged into several components. This Environmental and Social Impacts Assessment (ESIA) is for Component 3. Under component 3 of the EHPMP, specific community-focused cleaner technology demonstration activities in mercury-contaminated areas, selected and designed based on environmental health risks and cost-effectiveness of interventions, are due for implementation.

The government (through NEMC) proposed the establishment of demonstration centres in three different locations from among the 7 local regions participating in the EHPMP, including Shinyanga Region. In Msalala District, Shinyanga Region, the project will be implemented by the University of Dar es Salaam (UDSM) through the School of Mines and Geosciences (SoMG).

The estimated project budget is 350,000 USD, the implementation period is about six months and the project design life is 20 years.

DESCRIPTION OF THE PROJECT

The proposed CIP demonstration plant will serve the interests of organized Primary Mining Licences (PMLs) holders, current operators of washing ponds and VAT leaching Plants owners who usually have big size fresh ore to process. A gold processing plant of capacity 20tons/day (equivalent to 400 (20kg) bags of ore per day) will be established providing four phases of processing; comminution, gravity recovery, CIP recovery, elution & electrowinning processing and Smelting. The technology to be used is similar to one used by major mines i.e. Bulyanhulu Gold mine, but on a scale of a demonstration centre.

OBJECTIVES OF THE PROJECT

The overall objectives of the EHPMP is to provide means for addressing the challenges posed by mercury, in line with Minamata Convention, by developing strategies to promote emissions reductions from mercury (including mercury-free methods, managing trade, training); and developing public health strategies to reduce exposure of miners and their communities to mercury.

The specific objectives of the proposed demonstration center is pilot alternative technologies in ASGM and equip mining demonstration centres that can be used to train miners on the use and adaptation of alternative technologies. Furthermore, the demonstration centres will be used in carrying out further research that will add value to the adaptation of the alternative technologies.

A BRIEF DESCRIPTION OF THE PROJECT ENVIRONMENT

The proposed CIP demonstration plant will be established on an eight (8) acres piece of land at Bumva Village, Segese Ward, Msalala District in Shinyanga Region. The site is boarded on the east, west and south by open land, used by the locals for grazing. On the North, the site borders a public road. Adjacent the road further on the North, there exists a non-operational gold leaching plant. The distance to the nearest residential area is about 1.1km from the site. Furthermore there were no observed or reported sensitive environmental or social feature within the project site.

Bumva village is accessible via an earth road, which is in good condition. However, the access road to the site is not well defined and will need to be demarcated and developed during the project implementation.

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Tanzania is committed to attaining the Environmental Health and Pollution Management Project (EHPMP) objective. A few policies and legislation that have a close bearing to mining sector are; National Environmental Policy (NEP) of 2021; Mineral Policy of Tanzania, 2009; National Land Policy, 1997; National Water Policies (NAWAPO), 2002; Sustainable Industrial Development Policy, 1996; The National Investment Promotion Policy, 1996; Tanzania Women and Gender Policy (2000); National Forest Policy, 1998; The Wildlife Policy, 1998; The National Health Policy, 2003; National HIV/AIDS Policy 2001; Occupational Health and Safety Policy 2009; Human Resources Policy 2004; The Environmental Management Act, (No. 20), of 2004; Environmental Impact Assessment and Audit Regulations No. 349 of 2005 as amended in 2018; The Mining Act (No. 14), 2010 as amended in 2017; The Land Act Cap.113 R.E. 2002; The Village Land Act (No.5), 1999; The Village Planning and Regulation Act (No.58), 2007; The National Land Use Planning Act (No.6), 2007; The Tanzania Explosive Act Cap 45 R.E of 2002; The Tanzania Atomic Energy Act (No. 7), 2003; The Industrial and Consumable Chemicals (Management and Control) Act (No.3), 2003; The Water Resources Management Act (No.11), 2009; The Water Supply and Sanitation Act (No.12), 2009; The Energy and Water Utilities Regulatory Authority (EWURA) Act, 2001; The Wildlife Conservation Act (No.5), 2009; The Forest Act (No.14), 2002; The Occupational Health and safety Act (No. 4), 2003; The Employment and Labour Relations Act (No.6), 2004; The Workers Compensation Act (No. 20), 2008; The Prevention and Control of HIV/AIDS Act, 2008; Also the World bank Environmental and Social Standards (ESSs) and World Bank Group General Health Safety and Environment were reviewed.

STAKEHOLDERS CONSULTATIONS AND PUBLIC INVOLVEMENT

Key stakeholders were consulted during ESIA study, include the following; Kahama Commissioner’s Office, Regional Mines Office (RMO), Lake Tanganyika Basin Water Board, Msalala District Council, RUWASA-Kahama, Segese Ward Development Council (WDC), Bumva Village Community Assembly. Following stakeholders consultation and site visits a synthesis was done, and the following issues were identified:

i. The proposed site is rightfully owned
ii. There is a shallow well in the proximity of the site.
iii. The project site is also not in close proximity to any major river, lake or dam.
iv. The site is not connected to services such electricity. However, these are available about 1 km from the site.
v. There are no endemic species in the area/region.
vi. The Local Government at Bumva village, Segese ward, Msalala District, Shinyanga are optimistic that the project will bring out social economic benefits to community and the country in general.

vii. The scoping exercise was able to identify suitable sampling locations for social and environmental samples.

DESCRIPTION OF THE MAJOR SIGNIFICANT IMPACTS

Synthesis of stakeholder consultations indicated that the project was positively received by stakeholders at all levels. The most significant identified positive impacts include the expected social-economic benefits of project contribution towards development of the district; Control of contamination resulting from use of mercury; increased gold processing efficiency and improve small scale miner's income and environmental health. A number of negative impacts were also identified. The significant ones are impacts associated with health risks resulting from raise of commercial sex at mining areas contributing to relatively high prevalence of HIV/AIDS in the area.

ALTERNATIVES CONSIDERED

Consideration of project alternatives is crucial in ensuring that the developer and decision-makers have a wider base from which they can choose the most appropriate option. Two types of alternatives were considered as follows:

i. *No project alternative*

The no project alternative entails retaining the current status quo i.e. SoMG not to establish the proposed Gold Processing Centre at Msalala District. Adopting this option would mean avoiding most of the negative effects that might be associated with the presence the factor and development center at Shinyanga region, and missing all the social economic benefits of the proposed project. Surely, the implementation of the project has more socio economic benefits than the No project alternative.

ii. *Alternative Site*

Nyan'gombe village, Mwakitolyo ward, Shinyanga rural district - land issues – the area has a Prospecting license – hence owned by a private company hence expensive, size was fine.

iii. *Water Supply Alternative*

Four alternative water sources were considered for the facility. These are Water Supply (surface water) from the operating water utility company, groundwater extraction, rainwater harvesting and Industrial waste water recycling. It was concluded that water supply from RUWASA, rainwater harvesting and industrial waste water recycling to be appropriate for the proposed project.

iv. *Liquid waste Management Alternatives*

Five alternatives were considered for liquid waste management, namely stabilization ponds /lagoons; constructed treatment wetland; septic tank - soak away system for the domestic wastewater; and TSF for mineral processing plant.

v. *Alternative Energy Sources*

The developer considered three alternative sources of energy namely electricity (from the national grid), diesel power generators and solar energy. An evaluation of the three alternatives based on capital costs, availability of adequate supply, reliability, and environmental protection revealed the options could be used together. Therefore, it is planned to connect the site with electricity from the National grid as a basic power supply. Provisions will be made for installing solar panels in the future. However, since some machines requires high voltage, which could not be supplied by solar energy, standby generators will also be provided.

vi. Alternatives building materials

Five alternatives were considered for building materials namely, Concrete, Steel, Wood, Stones, Brick/masonry. A team of Architects and Engineers evaluates these based on criteria such as strength, weight and durability, which would make it right for various uses; compatibility with National standards and testing methods that govern the use of building materials in the construction industry; consideration for structural integrity and cost and aesthetics.

vii. Alternatives roofing materials

The project proponent considered various options in terms of roofing materials, among these coated aluminium roofing sheets and clay roofing tiles. The two materials were evaluated based on costs, availability, whether resistance, longevity, flexibility and corrosion resistance. Although roofing tiles score more points in terms of weather resistance, longevity and resistance to corrosion, they are known to be more expensive than aluminium roofing (i.e. per square meter). Aluminium roofing sheets score more point on capital costs, flexibility and less labor intensive during installation. Nevertheless, the contractor will opt for a more viable option.

IDENTIFIED ENVIRONMENTAL AND SOCIAL IMPACTS

The proposed establishment of a Gold Processing Demonstration Centre for Small Scale Miners at Bumva Village is expected be associated with several positive and negative environmental and social impacts and risks. The may feature during the planning, construction, operation and decommission phases of the project. These include:

Positive Impacts

i. Employment opportunity
ii. Economic gains to local community
iii. Knowledge Imparted to Local Practitioners
iv. Rapid urbanization of the area of following the increase of people
v. Improve Efficiency for Gold Production
vi. Environmental protection
vii. Improve Health and safety
viii. Regulatory compliance
ix. Market acceptance

Negative Impacts

i. Loss of village land which is acquired for gold processing project.
ii. Community safety and cultural integrity
iii. Increase Traffic Load
iv. Air quality Deterioration
v. Generation of Noise and Vibration
vi. Increase generation of Solid Waste
vii. Population Influx and Transmission of HIV/AIDS
viii. Removal and disturbance of flora
ix. Loss of Fauna habitat
x. Occupational Safety and Health Risks
xi. Increase Generation and Impacts associated with poor management of waste water (i.e. from sanitary facility & TSF)
xii. Soil erosion potential
xiii. Increase Storm water flow
xiv. Loss of Employment due to Closure of the Project

ENVIRONMENTAL AND SOCIAL MANAGEMENT

With good housekeeping, adoption of cleaner production principles and good engineering practices, the predicted impacts could be avoided, minimized, and/or managed below environmental quality standards. Many of the mitigation measures put forward are nothing more than good engineering practices and standard industrial operating procedures that shall be adhered to during all the project phases. The options to minimize or prevent the identified adverse social and environmental impacts as well as a monitoring plan have been suggested in this report and are contained in the ESMP. The ESMP defines the roles and responsibilities of different actors of the plan. The associated annual environmental costs amount to 92,000,000 TSH. UDSM is willing to implement the proposed mitigation measures and other relevant guidelines to ensure project sustainability and environmental protection.

PROPOSED MONITORING AND AUDITING

Environmental monitoring and auditing shall form an essential component of this project. An Environmental Monitoring Plan has been prepared, providing a mechanism for monitoring environmental impacts of a project during its execution in order to reduce their negative effects and to introduce standards of good practice to be adopted for all project works. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures proposed in the EMP. The parameters of the proposed project identified for monitoring include; water quality, air quality, waste generation, and occupational health and safety risks. The monitoring plan provides details of the attributes to be monitored, frequency, and institutional responsibility, and estimated costs. These costs are only approximations and therefore indicative.

DECOMMISSIONING

Decommissioning is not anticipated in the near future. However, if this will happen, may entail a change of use (functional changes) or demolition triggered by a change of land use. In view of this, specific mitigation measures pertaining to the environmental impacts of decommissioning works cannot be proposed at the moment with a reasonable degree of certainty. A detailed decommissioning plan that takes environmental issues into consideration shall be prepared by the developer prior to the decommissioning works. Should it be done, decommissioning may entail a change of use (functional changes) or demolition triggered by a change of land use.

CHAPTER ONE

1 INTRODUCTION

1.1 BACKGROUND

The Environmental Health and Pollution Management Project (EHPMP) is a five-year (July 2020–July 2025) Global Environmental Facility (GEF) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana. The World Bank conceptualized the project under funding from GEF. The EHPMP aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries.

ASGM uses mercury in gold recovery in a manner that is dangerous to human health and the environment because amalgamation is done with bare hands and the amalgam is heated in open air to drive away the mercury. Furthermore, the available literature indicates that in ASGM for every 1 kg of gold recovered, about 2 kg of mercury is used and most of it is released into the environment (VPO, 2020). In response, the government, through EHPMP intend to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region, to pilot alternative technology.

The EHPMP project operated in seven regions of Shinyanga, Songwe, Mwanza, Mara, Geita, Singida and Mbeya. The EHPMP is packaged into several components. This Environmental and Social Impacts Assessment (ESIA) is for Component 3. Under component 3 of the EHPMP, specific community-focused cleaner technology demonstration activities in mercury-contaminated areas, selected and designed based on environmental health risks and cost-effectiveness of interventions, are due for implementation.

The government (through NEMC) proposed the establishment of demonstration centres in three different locations from among the 7 local regions participating in the EHPMP, including Shinyanga Region. In Msalala District, Shinyanga Region, the project will be implemented by the University of Dar es Salaam (UDSM) through the School of Mines and Geosciences (SoMG).

1.2 THE PROJECT OBJECTIVES

The overall objectives of the EHPMP is to provide means for adressing the challenges posed by mercury, in line with Minamata Convention, by developing strategies to promote emissions reductions from mercury (including mercury-free methods, managing trade, training); and developing public health strategies to reduce exposure of miners and their communities to mercury.

1.2.1 Specific Objectives

The objectives of the proposed demonstration center is pilot alternative technologies in ASGM and equip mining demonstration centres that can be used to train miners on the use and adaptation of alternative technologies. Furthermore, the demonstration centres will be used in carrying out further research that will add value to the adaptation of the alternative technologies.

1.3 JUSTIFICATION OF THE PROJECT

The proposed project is justified by the existing hazardous operations of Artisanal and Small-Scale Gold Miners (ASGM). The ASGM use mercury in gold recovery but the entire process is dangerous to human health and the environment because amalgamation is done by bare hands and the amalgam is heated in open air to drive away the mercury. Available literature indicate that in ASGM for every 1kg of gold recovered about 2 kg of mercury is used and most of it is released into the environment.

In response to threats that Mercury poses to human health and environment, the Government came up with the proposed demonstration center through the EHPMP, inorder to introduce alternative technologies to mercury for gold recovery in ASGM subsector. These include ASGM, Service providers, Local communities surrounding the mining sites and Regulators.

1.4 JUSTIFICATION OF ESIA STUDY

The objectives of this Environmental and Social Impact Assessment are to:

- Establish the baseline conditions of the study area through a combination of desk review, consultations and site visits taking account of any committed development projects which could change the baseline in the future;
- Identify environmental constraints and opportunities associated with the study area which may influence, or be affected by the proposed technologies;
- Identify and assess any environmental impacts (both positive and negative) which could result from the proposed project;
- Identify and incorporate into project design and operation, features and measures to avoid or mitigate adverse impacts and enhance beneficial impacts; and
- Assess the level of significance of all residual effects (direct and indirect, adverse and beneficial, short-term and long-term, permanent and temporary) taking into account of the proposed mitigation measures

This ESIA encompasses the following:

Content		Description
Executive summary	-	Summarize the key points of the report.
Introduction	-	Describes project background, objective of the project and justifies the project and the ESIA study
Project Description	-	Describes the proposed project and its geographic, environmental, social, and temporal context, including any offsite investments that may be required (e.g., dedicated

Content	Description
	pipelines, access roads, power supply, water supply, housing, and raw material and product storage facilities), - Entails the project's primary suppliers. Through consideration of the details of the project, indicates the need for any plan to meet the requirements of ESS1 through 10 and the National legislation.
Legal and Regulation Framework	- Analyzes the legal and institutional framework for the project, within which the environmental and social assessment is carried out, including the issues set out in ESS1. - Comparison between the Borrower's existing environmental and social framework and the ESSs, identification of the gaps between them and measures to fill the gaps. - Compliance with World Bank Group Environmental, Health and Safety Guidelines - Where applicable, Identification and assessment of the environmental and social requirements of any co-financiers.
Baseline Data	- Identifies the baseline data that is relevant to decisions about project location, design, operation, or mitigation measures. This includes estimation of the extent and quality of available data, key data gaps, and uncertainties associated with predictions. - Based on current information, assesses the scope of the area to be studied and describe relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. - Takes into account current and proposed development activities within the project area but not directly connected to the project. - Site investigation results
Public consultation and information disclosure	- This describes the Stakeholder engagement plan and Grievance Redress System
Alternatives analysis	- Site selection criteria - For each of the alternatives, quantify the environmental and social impacts to the extent possible, and attaches economic values where feasible. - With and without Project scenario

Content	Description
	- Description of selected site Feasibility of project in selected site i.e environmental, social and economic
Environmental & Social Risks and Impacts	- Describes all relevant environmental and social risks and impacts of the project. Its include the environmental and social risks and impacts specifically identified in ESS2–8, and other environmental and social risks and impacts arising as a consequence of the specific nature and context of the project, including the risks and impacts identified in ESS1, - It includes the positive environmental and social outcomes as well.
Mitigation Measures	- Identifies mitigation measures to manage the environmental and social impacts and significant residual negative impacts that cannot be mitigated and, to the extent possible, assesses the acceptability of those residual negative impacts. - Identifies differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable. - Assesses the feasibility of mitigating the environmental and social impacts; the capital and recurrent costs of proposed mitigation measures, and their suitability under local conditions; and the institutional, training, and monitoring requirements for the proposed mitigation measures. - Specifies issues that do not require further attention, providing the basis for this determination. - Covers Environmental and workers health and safety measures. - Includes a monitoring plan identifying parameters to be monitored, frequency and responsible authority.
Key Measures and Actions for the Environmental and Social Commitment Plan (ESCP)	- Identifies key measures and actions and the timeframe required for the project to meet the requirements of the ESSs. - This will be used in developing the Environmental and Social Commitment Plan (ESCP).
Institutional Arrangements and Reporting	- Describes the policies, systems, and processes that guide the ESIA.
Appendix	- List of the individuals or organizations that prepared or contributed to the environmental and social assessment.

Content	Description
	- References—setting out the written materials both published and unpublished, that have been used. - Record of meetings, consultations and surveys with stakeholders, including those with affected people and other interested parties.

1.5 REGULATORY REQUIREMENTS FOR ESIA

ESIA is a requirement by both the Nation laws and the lenders guidelines. The Environmental Management Act (EMA) 2004, and the first schedule of The Environmental Management (Environmental Impact Assessment and Audit) (Amendment) Regulations (United Republic of Tanzania, 2018) detail the types of projects requiring and not requiring ESIA. This project falls in Type A, requiring a mandatory ESIA. Type A Projects are likely to have significant adverse environmental impacts and that in-depth study is required to determine the scale, extent and significance of the impacts and to identify appropriate mitigation measures. The EMA guides environmental management and is administrated by the National Environmental Advisory Committee, the Directorate of Environment and the NEMC (United Republic of Tanzania, 2004). The NEMC's decision regarding the project will be based on the information emerging from this EIA process provided in the final EIS. Further, the World Bank Environmental and Social Framework (ESF) requires the Borrower to conduct ESIA, in accordance with the requirements of the Environmental and Social Standard 1 (ESS1): Assessment and Management of Environmental and Social Risks and Impacts. ESS1 applies to all projects supported by the Bank through Investment Project Financing. ESS1 requires the Borrower will undertake an environmental and social assessment to assess the environmental and social risks and impacts of a project throughout the project life cycle. The EIA study was preceded a by Scoping exercise, which established the scope of EIA, and developed TOR for the study. The Scoping Exerices was done and Approved in October, 2023 (refer to Appendix IX for approval letter and ToR).

1.6 PROJECT COSTS AND TIME LINE

The estimated project budget is 350,000 USD. The implementation period is about six months. The project design life is 20 years

1.7 REPORT STRUCTURE

Chapter one contains the introduction on the background information of the proposed project, its development objectives, rationale and the proposed project implementation arrangements.

Chapter two contains the project description, in which there is a description of the location and relevant components of the project and their activities.

Chapter three illustrates policy, legal and administrative framework, which are the relevant Tanzanian environmental policies and legislation applicable to construction projects.

Chapter four has the baseline information relevant to environmental characteristics, which gives details concerning the Bio-physical environment and socio-economic environment at the project area.

Chapter five express the consultation exercise at the project area detailing the list of stakeholders consulted and the issues raised.

Chapter six describes the positive and negative environmental impact of the project that are likely to be generated from the different phases (the planning and designing, construction, operation and maintenance and the demobilization phases).

Chapter seven gives the mitigation measure for the potential negative impact of the project.

Chapter eight presents the Environmental and Social Management Plan (ESMP).

Chapter nine presents the Environmental Monitoring Plan that contains the proposed institutions to carry out the monitoring activities, the monitoring indicators, time frame and the proposed budget for monitoring.

Chapter ten gives the cost benefit analysis of the project.

Chapter eleven provides the decommissioning plan for the proposed project however the decommissioning is not anticipated in the foreseeable future.

Chapter twelve gives the summary and conclusions of the study.

Appendices, containing some key primary information collected during the study are attached at the end of this report. Generally, the report structure flows in conformity with that specified in the EIA and Audit Regulations of 2005 and its amendments of 2018.

CHAPTER TWO

2 DESCRIPTION OF THE PROJECT

This section is dedicated to describing the project location, activities and its design.

2.1 THE DESCRIPTION OF THE SITE AND ITS LOCATION

The proposed CIP demonstration plant will be established on an eight (8) acres piece of land at Bumva Village, Segese Ward, Msalala District in Shinyanga Region (Figure 2-1). The village is among the five villages in Segese Ward. The village has other 36 gold processing plants, utilising mercury, and operated by the local miners. The site coordinates and site layout plan are shown in Figure 2-2.

Bumva village is accessible via an earth road, which is in good condition. However, the access road to the site is not well defined and will need to be demarcated and developed during the project implementation.

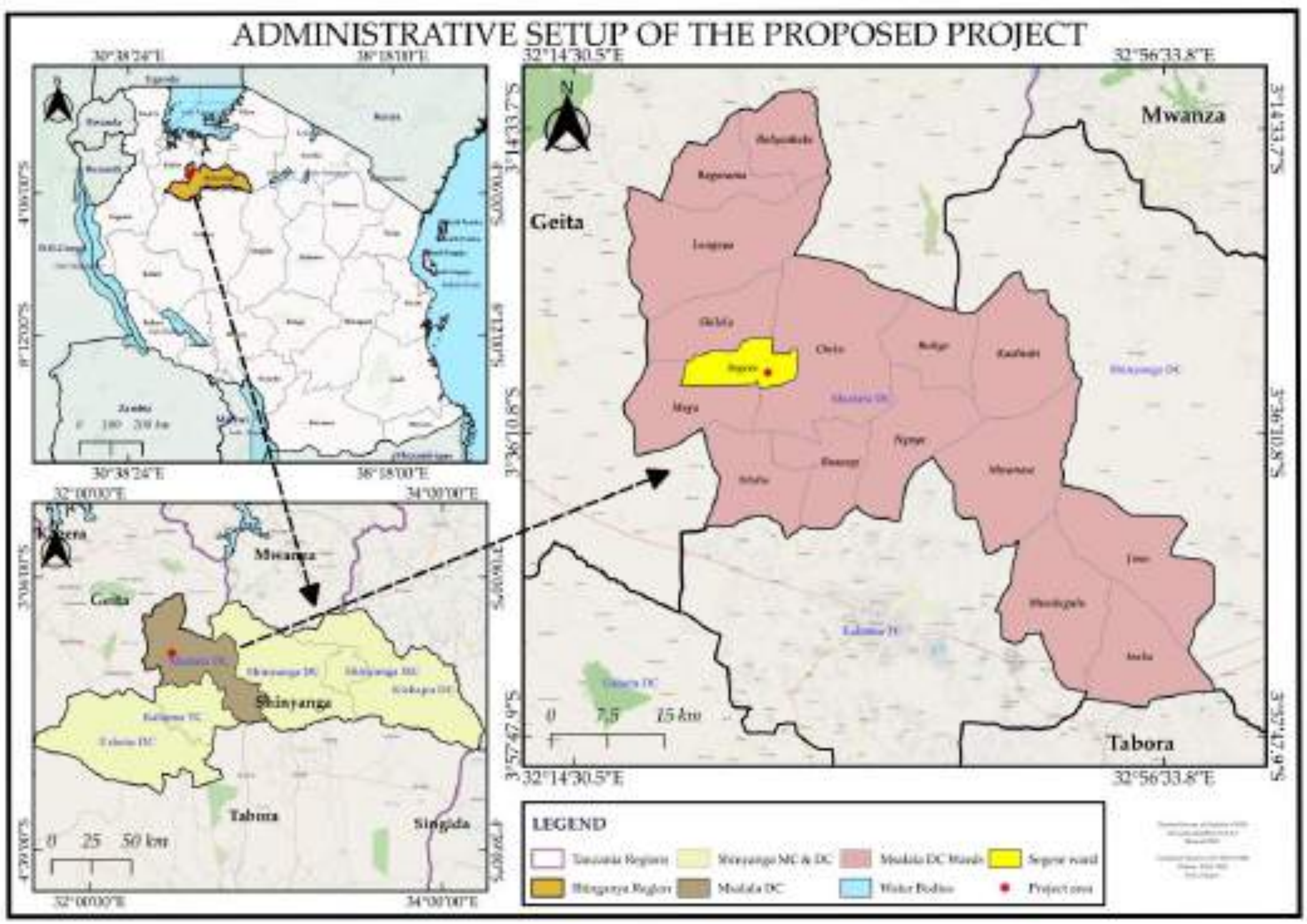


Figure 2-1: Maps showing the location of Shinyanga Region, and Segese Ward.

Table 2-1: The proposed site corners coordinates

POINT	Decimal Degree		UTM	
	Latitude	Longitude	Easting	Northing
A	-3.52833159	32.45987602	440010	9609991
B	-3.52982434	32.45999220	440023	9609826
C	-3.53010386	32.45840745	439847	9609795
D	-3.52862903	32.45799415	439801	9609958

2.1.1 The Site Layout

Within the plot, the location of the CIP demonstration plant site was primarily driven by the selected location of the Run of Mine (ROM) pad and favourable site topography. The processing plant layout reflects the sequential nature of the processing operations with ROM received at one end and the final product at the other end. The facility layout for the site is prepared and included in Figure 2.2. The proposed CIP demonstration plant is laid out in a manner to minimise the overall foot print, to facilitate the flow of process streams and provide ease of operator and maintenance access. However the proposed project component shall be constructed to occupy 1/3 area (2.667 acre) of the total plot size.

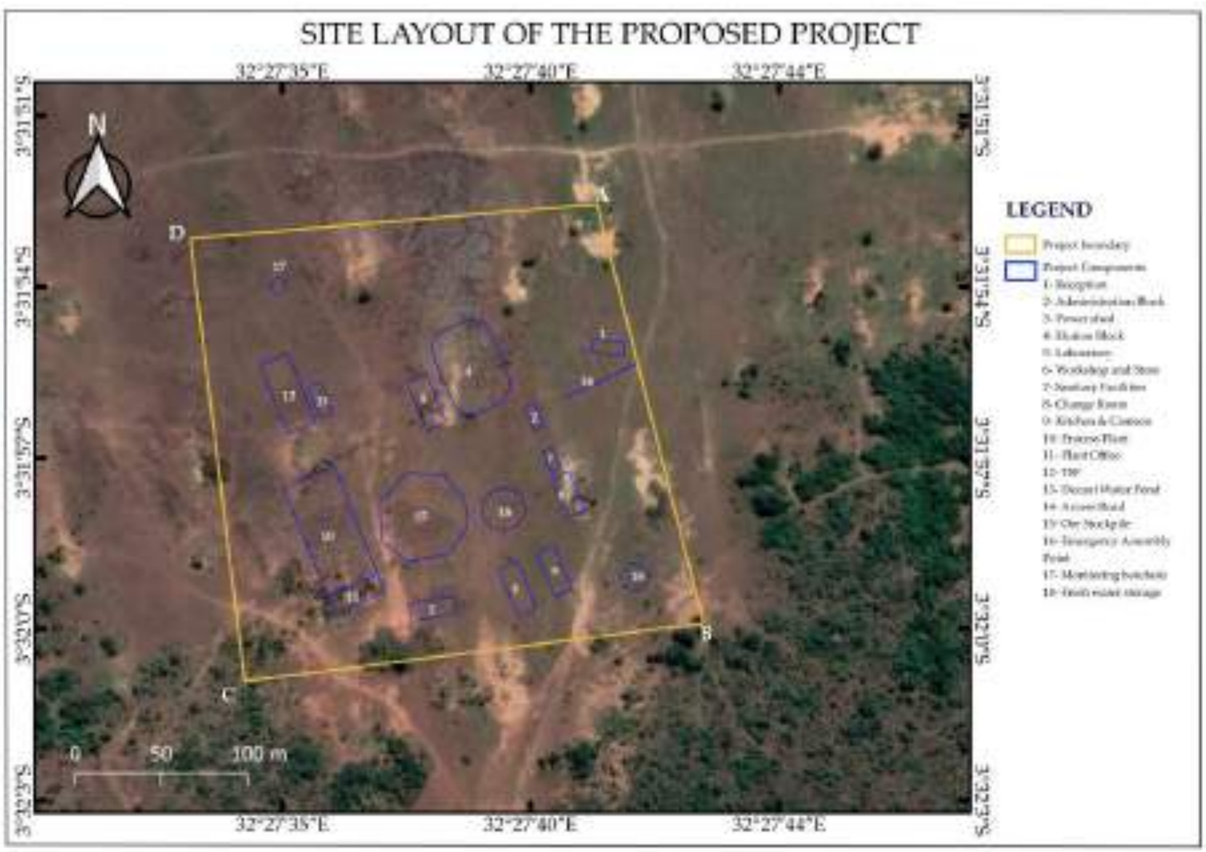


Figure 2-2: Satellite Image showing the layout of components on the proposed site

Source: Consultant, 2024

2.1.2 Current zoning and Adjacent land use

The site is within the village land, and is undeveloped. The adjacent land use is composed of grazing land and commercial land. The site is boarded on the east, west and south by open land, used by the locals for grazing. On the North, the site borders a public road. Adjacent the road further on the North, there exists a non-operational gold leaching plant.

2.1.3 Distance to the nearest residential area

The distance to the nearest residential area is about 1.1km from the site. The residential settlements near the sites are scattered, located at about 800 m apart. There is a primary school (Bumva Primary school), located about 2.5 km from the site. There were no observed or reported sensitive environmental or social feature within the project site. Adjacent to the site, on the northern side, there is a *borehole* and an elevated fresh water water storage tank, within the premises of an adjacent used by the non-operational Gold processing plant.

2.1.4 Sensitivity of the project area

There is no observed or reported sensitive environmental or social feature within the project site. Adjacent the site, on the north, there is a ***borehole*** used by the non operational Gold processing plant.
A baseline survey on flora and fauna found no sensitive areas such as critical natural habitats on the proposed site. The area is neither a Protected area nor a wildlife corridor/buffer zone/dispersal area. No marine and aquatic habitats at the area. It was also found that no unique or particularly national-listed threatened or endangered animal species are present within or near the project area. All species recorded are widely distributed in many parts of Tanzania.

2.1.5 Land Ownership

The Developer intends to establish the proposed CIP demonstration plant on 8 acres piece of land at Bumva Village, Segese Ward, Msalala District in Shinyanga Region. The proposed site is on a village land, and was previosly owned by the village government authority. However UDSM have obtain legal ownership of the proposed Land, See Appendix VII.

2.2 THE PROJECT COMPONENTS

The proposed CIP demonstration plant will have the following components

i. Administration Building

This is the central office space where the administrative functions of the plant are carried out. It houses offices for management, engineering, procurement, accounting, and other administrative staff, occupying an area of 88m^2

ii. Laboratory building

This facility will be equipped with specialized equipment for analyzing ore samples, monitoring process parameters, and ensuring quality control throughout the processing operations. It houses instruments such as spectrometers, atomic absorption spectrophotometers, and fire assay furnaces for gold analysis.

iii. Workshop and Store

This facility provides space for maintenance, repair, and fabrication of equipment and machinery used in the plant and mining operations. It also serves as a storage area for spare parts, tools, and supplies.

iv. Ore Stockpile

This is a designated area for storing ore before it is fed into the processing plant. The stockpile ensures a consistent supply of ore to the plant.

v. Processing Plant

This is a facility where the ore will be crushed and ground processed to extract valuable minerals, particularly gold, in favorable size for the elution process. It consists of units such as crushers, and grinding mills.

vi. Elution Area

This is where the loaded carbon, which has absorbed gold during the leaching process, is stripped of the gold using a hot caustic/cyanide solution in a process called elution. The recovered gold is then further processed for refining. The area will consist of an elution administration office, a chemical store, a digestion room (Containing flotation cells, leaching tanks, carbon columns, gold recovery circuits, etc.), a resting room, and an elution fence wall.

vii. Tailing Storage Facility (TSF)

This is a facility where the processed waste material from the plant, known as tailings, will be stored. The TSF is engineered to safely contain and manage the tailings to minimize environmental impact and shall have a capacity of 22,000m^3.

viii. Decant Water Pond

This is a containment area for storing clarified water decanted from the tailings thickener. The water in the decant pond is recycled and reused in the processing plant to reduce the demand for freshwater sources and minimize environmental impacts.

ix. Power room

This room shall contain a standby generator, switchgear, and other electrical equipment necessary to supply electricity to the entire plant site. It shall ensure a reliable power supply for operating various equipment and machinery.

x. Fresh water storage facility

10m^3 elevated water reservoir will be provided and supported by a steel structure, water shall be sourced from an onsite drilled borehole water source and pumped to the reservoir.

xi. Kitchen and Canteen

These facilities provide meals and refreshments for the plant's workforce. They will be essential for maintaining the health and well-being of employees during their shifts.

xii. Access Road

Access roads within the plant area will provide transportation routes for vehicles and equipment moving between different sections of the facility. They are to be constructed to withstand heavy traffic and facilitate safe and efficient movement around the site.

xiii. Changing room

These are rooms offering a space for employees to change into and out of their work attire and will be provided for both genders separately.

xiv. Sanitary facility

These facilities will be provided for the convenience and comfort of the plant's workforce toilets and bathrooms together with the wastewater collection system, particularly the septic tank ($3.6m^3$) and soak-away pit ($3.6m^3$) to accommodate all the wastewater from both male and female sanitary facilities.

xv. Monitoring borehole

A monitoring borehole will be drilled at strategic locations around the plant site to monitor groundwater levels, quality, and flow direction, it provides data for assessing environmental impacts, ensuring compliance with regulations, and guiding remediation efforts if needed. The borehole shall serve as an early warning system for potential environmental issues and support sustainable plant operations by facilitating informed decision-making.

xvi. Light and security system

The light and security system will comprise comprehensive lighting arrangements, including general, task, emergency, outdoor, complete CCTV camera, electric sport light 150W, and motion-activated lighting, ensuring optimal visibility and safety across the plant premises.

xvii. Emergency Assembly Point

This is a designated location where employees gather during emergencies, such as a fire, chemical spill, or TSF failure, to receive instructions and assistance from emergency responders.

2.3 DESCRIPTION OF THE PROJECT COMPONENTS DESIGN

2.3.1 DESIGN OF THE CIP DEMONSTRATION PLANT

The proposed Carbon in Pulp (CIP) Plant demonstration plant will serve the interests of organized Primary Mining Licences (PMLs) holders, current operators of washing ponds and VAT leaching Plants owners who usually have big size fresh ore to process. A gold processing plant of capacity 20tons/day (equivalent to 400 (20kg) bags of ore per day) will be established providing four phases of processing; comminution, gravity recovery, CIP recovery, elution & electrowinning processing and Smelting. The process flow sheet is as present in Figure 2-3. The technology to be used is similar to one used by major mines i.e. Bulyanhulu Gold mine, but on a scale of a demonstration centre.

The CIP process plant route summarized in Figure 1 will comprise of:

- Two stage crushing to 80% passing (P80) size of 5-15 mm;
- Single stage grinding with ball mill closed with hydrocyclones to generate an overflow P80 size of 106 µm;
- Centrifugal concentrators for treating coarse gold containing ores;
- Cyanidation with 3 conventional CIP tanks each with 15 m^3 and 12 Pachuca tanks of 2 m3 each, making a total volume of 69 m^3;
- Carbon recovery screen to serve carbon during offloading and carbon safety screen to protect carbon from escaping to TSF in case of inter tank screen damage;
- 70 m^3 detoxification tank for reduction of cyanide levels to between 20-50 mg/L before discharge of the tailings to the TSF;
- Elution-Electrowinning circuit for gold striping from loaded carbon as well as final recovery from the electrowinning process;
- Reagent mixing, storage and distribution facilities;
- Water and air supply, storage and distribution facilities.

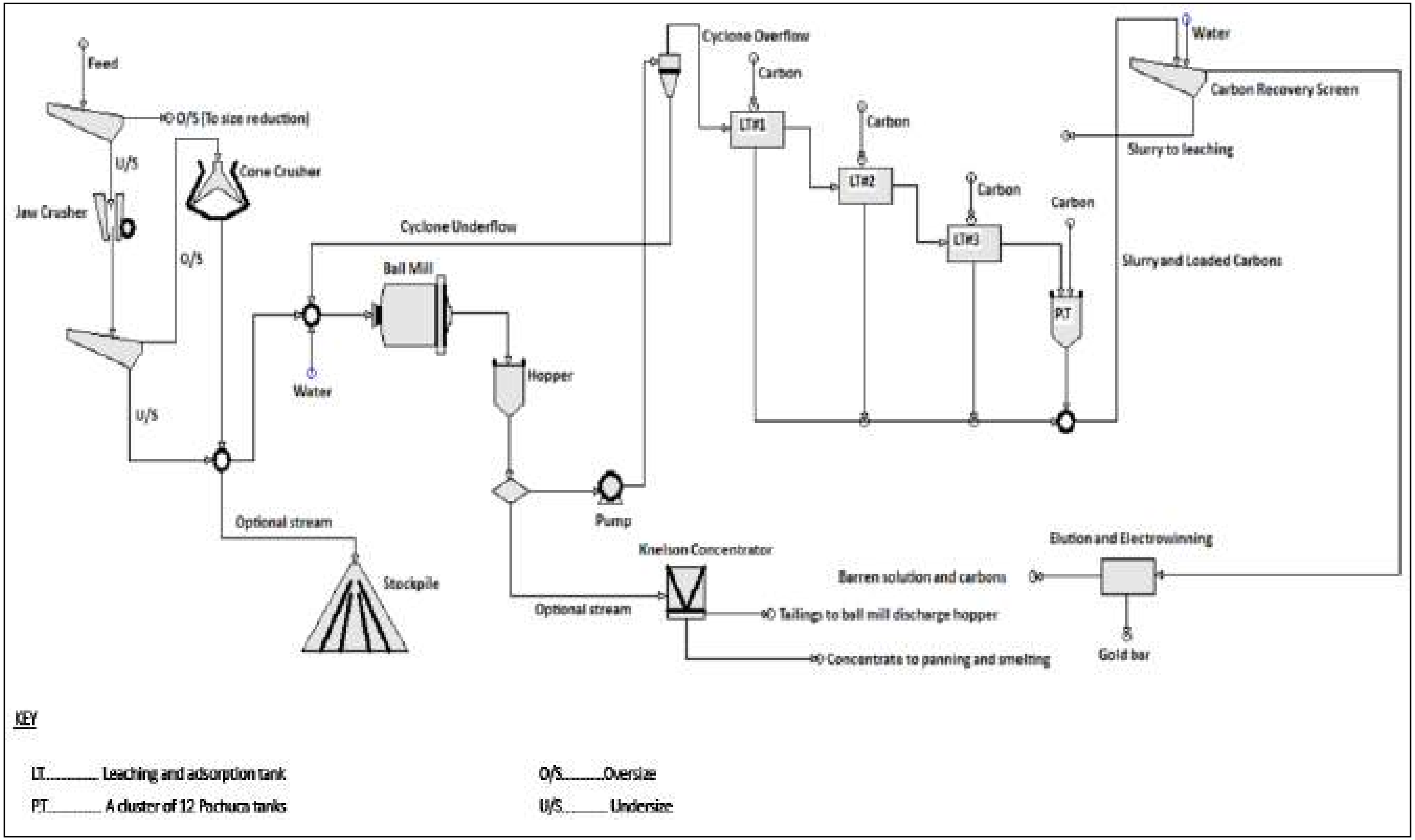


Figure 2-3: The proposed CIP-Process Flow Sheet (UDSM, 2023)

2.3.2 Process and Plant Description

The process plant description should be read in conjunction with the process plant overall flowsheet (Figure 2-3) and detailed process plant drawings contained in Appendix IV. The mechanical equipment as well as auxiliary facilities list is attached in Appendix V.

2.3.2.1 Crushing Operation

i) Primary Crushing

The crushing circuit will process the ROM ore at an average rate of 30 t/d. A Jaw crusher with reduction ratio of 5:1 is proposed for the primary crushing stage. The ROM ore will be trucked from small scale miners and stockpiled on the ROM storage pad and then reclaimed by a 1tonne Front-End Loader (FEL) to the Jaw crusher. The crusher will handle the ROM ore with an average lump size of 200 mm and the designed feed rate of 2 t/hour with discharge gape size of 40 mm. Ore material from the ROM pad will enter the Jaw crusher through grizzly screen, where the screen undersize will be directed to the jaw crusher, which will crush the material to a P80 of approximately 30 mm. The grizzly screen oversize material will be subjected to a size reduction process before re-feeding to the jaw crusher.

Dust Control: Water hoses will be installed at different areas around the crushing plant for suppressing dust generated during ore unloading at ROM pad as well as during crushing operation.

ii) Secondary Crushing

The primary crusher product will be conveyed to a single deck screen where the undersize material will drop through the chute to the conveyor belt to the coarse ore stockpile or ball mill feed surge bin before being fed to the ball mill while the oversize material will drop into a cone crusher through a conveyor belt with a magnet at the top of the belt to trap trashes with magnetic properties such as iron. The cone crusher will have a discharge size of approximately 5-15 mm. The product from the cone crusher will join the primary crusher screen undersize and be conveyed to coarse ore stockpile or ball mill feed surge bin.

2.3.2.2 Grinding operation

The grinding circuit will consist of a ball mill operating at a nominal rate of 2 t/hour and closed with classifying cyclones. The crushed ore from the surge bin/Stockpile will be reclaimed onto the ball mill feed belt conveyor that feeds the ore to the mill. The crushed ore will be mixed with water as it enters the mill. Steel balls will be manually added into the ball mill on a batch basis as grinding media. Dilution water will be added to the grinding circuit as required. Lime will also be added in order to maintain slurry pH at 10.5 or higher. The ball mill will have 30 kW of total installed grinding power providing sufficient power for the duty feed rate at the predicted feed.

The product from the ball mill will be discharged into the mill discharge transfer pump box, where the slurry will be pumped to the cyclone for classification. The cyclone underflow will return to the ball mill, creating a circulating load to the ball mill of approximately 250%. The cyclone overflow with a P80 of 106 µm will flow by gravity to the conditioning tank for subsequent cyanidation treatment. If the ore contains coarser gold particles/nuggets, the ball mill product will be directly fed to centrifugal concentrators for coarser gold recovery. The concentrate obtained from the gravity circuit will be further treated through prospecting pans to obtain final gold concentrate before smelting.

2.3.2.3 Classification

The designed CIP plants will employ one cluster of hydrocyclones for the classification of mill discharge material before the leaching process. Therefore, in order to achieve the plants' capacity of 20 tonnes per day (dry solid), a hydrocylone with the pressure of 0.06-0.35 MPa and a volumetric flow rate of 8-15 m3/h will be installed and used to achieve a classification to 106 microns overflow product. There will be two hydrocyclones, one operational at a time and the other standby, in case of emergency.

A slurry pump with capacity of 10-22 m^3 /h, a head of 37-46 m and a speed of 1400-3400 rpm, will be installed and used to pump the mill discharge to the hydrocyclones. There will be two slurry pumps for cyclone feed, whereby one will be operating and the other standby.

It is designed that, the Hydrocyclone produces the ooverflow (finer particles<100 microns) and the Underflow (ccoarser particles >100 microns).

The overflow product will report to tonnage box at the leaching circuit, then from the tonnage box to the leaching tank where reagents from the mixing/conditioning tank are charged for leaching. The underflow will be discharged by gravity to the Ball mill for re-grinding via an HDPE pipe.

2.3.2.4 Leaching Circuit

- Tonnage box

This is rectangular box which will be installed at the leaching unit to control plant feed capacity and will have a volume of 1 m^3. When the plant is running, the tonnage box will receive the overflow from the hydrocyclone and at this point the volumetric flow rate of the slurry will be determined using a stop watch. The mass flow rate of the slurry and dry solids can be calculated and the plant capacity can be monitored.

- Reagents mixing

Several tanks will be in place for preparation of reagents for use in the leaching operation. The ASGM Demonstration Plants will have three reagent mixing tanks:

i. Cyanide mixing tank (500 litres)
ii. Hydrogen peroxide /lead nitrate/ammonium nitrate mixing tank (200 litres)
iii. Reagent mixing tank for sulphide minerals treating (200 litres)

- CIP Tanks

The leaching circuit is designed to treat a minimum capacity of 20 dry tonnes per day and will be achieved using 15 tanks. In this setup, three will be conventional tanks each with the overall capacity of 15 m^3 and 12 Pachuca tanks of 2 m^3 each, making a total volume of 69 m^3. One, 15 m3 tank will be used for conditioning of the leach feed and the rest of the tanks will be for leaching. The leaching operation is designed for the percentage solids of 45-55. The Tails from the last leaching tank will be directed to the detoxification tank prior discharge to the tailings storage facility (TSF).

- Intertank screens

The leaching tanks will incorporate intertank screens for retaining the loaded carbon within a specific tank to maintain the carbon profile while letting only the slurry to pass from one tank to the next by gravity.

- Agitation system

For the conditioning tank and two other larger conventional tanks, the slurry will be stirred by a motor driven agitator. For the rest of the Pachuca tanks, the stirring will be achieved by compressed air. Further, the first three conventional tanks will also be supplied with compressed air for improving cyanidation process.

- Carbon screen

The plant will also be installed with the carbon screen (Trommel type) at the last tank to serve carbon during offloading and also to protect carbon from escaping to TSF in case of inter tank screen damage.

- Open shower and CN antidote point

An emergency shower will be installed at the CIP plant for emergency washing in case of workers chemicals contacts during operation at the plant. There will also be a CN antidote point for emergency CN intake.

2.3.2.5 Detoxification

The Cyanide detoxification Circuit within the processing plant is designed to reduce the cyanide concentration in the tailings slurry water to less than 20mg/L. The cyanide detoxification tank will follow immediately after the CIP circuit and will receive the taillings slurry from the Carbon safety screen sump through a pump.

The detoxification tank will have a volume of 70 m^3, which will provide 7 hours designed retention time to allow the detoxification process to occur. Compressed air will be injected at the bottom of the tank and two treatment reagents: Sodium Metabisulphite (Na_2S2O_5) and Copper Sulphate ($CuSO_4$), will be added from the top of the treatment tanks in a dissolved form to be mixed into the tailings slurry within a controlled pH range of 8.0 to10.0.

It is estimated that one tailling pump rated at 7.5 kW will be used to pump the treated slurry to the tailling storage facility.

2.3.2.6 Elution and Electrowinning

Loaded carbon feeding the elution Column will be recovered from the Carbon recovery Screen whereby before elution, the carbon will be washed with 3% hydrochloric acid (i.e. both acid wash and elution will be conducted in the same unit). Following acid washing, the carbon will be rinsed with water before addition of caustic for elution process to be initiated.

The Strip Solution will be preheated through heat exchanger to 90°C for 3-hours and 3- hours later at elevated temperature and pressure so that it attains 120^{o}C.

The Single 2-cathode electrowinning cell, with a connected 20-amp rectifier will recover gold from the pregnant eluate for a duration of 18 hours. After completion of electrowinning process, the cathode steel wire full of gold sludge is subjected to acid digestion process using a mixture of Sulphuric and Nitric acids at a ratio of 1:1 in the Steel wire digestion chamber, where gold sludge is squeezed and mixed with fluxes before smelting in an electrical or Gas fire Smelter then cast into bullion bars.

Once the elution is cycle is complete, the barren eluate is discharged off into Barren solution tank and the carbon is removed from the elution column through the opening at the bottom side of the column.

2.3.2.7 Tailings Disposal

Tailings from the detoxification process (25-45% solids) will be pumped to the tailings storage facility (TSF) through a High-density polyethylene (HDPE) pipeline. The TSF will be designed such that the process water will be recovered from the TSF and pumped back to the Process Plant for reuse. A 7.5kW slurry pump will be installed to transport tailings from the leaching plant to the TSF. The pump will have to handle a flow rate of (10-22)m^3/h and operate at speed of 1400-3400 rpm.

2.3.2.8 Reagents storage

Sufficient stocks of reagents (i.e., cyanide, lime, caustic soda, Nitric and hydrochloric acids, lead nitrate, hydrogen peroxide, etc.) will be stored at the plant to ensure that supply interruptions do not affect the production.

2.3.2.9 Plant Services

- Fresh water

Fresh water for the process plant operation will be supplied through water boreholes that will be drilled close to the project area. Water from the boreholes will be pumped to the fresh water storage tank located at the process plant.

Apart from process plant operation, the fresh water will also be used for the following:

- Dust suppression sprays;
- Reagent mixing;
- Laboratory; and

- Plant Fire Water Tank.

- Process Water

Water recovered from the tailing's storage facility (decant water return) will be pumped to the process water tank for plant use. If required, water make up will be drawn from the raw water tank. The volume of the process water tank will have to accommodate up to 24 hours of plant operation in the event of failure of supply from the TSF or boreholes.

- Fire Rescue

Sufficient stocks of firefighting chemicals/material (i.e., fire blanket, fire extinguisher -dry powder chemical/carbon dioxide) and fire monitoring devices (smoke detector) will be available around the project compound for encountering all fire accidents.

- Air Services

A set of air compressors will supply high pressure plant air which will be stored in a plant air receiver for distribution around the process facility. The plant air will supply service points throughout the plant. The air will be filtered and dried before being stored for plant uses.

- Emergency Power Generation

A 200 kVA emergency diesel generator will be installed at the process plant and will provide emergency power during power cuts. The generator will be connected to the LV switchgear using manual change over switches. The generator will only supply essential power to run specific drives in the process plant and emergency power requirements. Furthermore, a lighting plant will also be part and parcel of the emergency power support for the plant operation.

- General infrastructure

The general infrastructure will consist of construction of access road, earthworks terraces, fence, air supply, fresh and process water storage tanks, firewater storage tank, plant administration building and offices, plant workshop and stores, laboratory, rest house, change rooms, toilets and bathrooms, canteen, and security shed.

2.4 THE PROJECT IMPLEMENTATION PLAN

For purpose of the ESIA study, the project implementation is divided into five activities, namely the pre-construction, construction, commissioning, operation and decommissioning activities. Activities to be conducted in each phase as described hereunder:

2.4.1 Pre-Construction/Mobilization Phase Activities

This is the planning phase of the project. Activities to be conducted include; conducting a feasibility study (including surveys and preparation of preliminary engineering drawings), followed by detailed engineering design of the project, conducting an Environmental and Social Impact Assessment (ESIA) including stakeholder's sensitization and other relevant activities. The scoping exercise is the first stage of the EIA process. The subsequent stage will be to conduct the detailed Environmental and Social Impact Assessment (ESIA), for which after approval by NEMC, the project will be awarded an EIA certificate. In this phase, UDSM will also apply for other relevant permits such as building permit, processing permit, Lake Tanganyika Basin Water Board, procurement of contractor(s) etc.

2.4.2 Mobilization Phase Activities

This phase will commence after procurement of the contractors and award of EIA certificate by NEMC. This phase may last for about a month, and will involve the following activities:

- Procurement of service providers and suppliers of various goods and services for project development;
- Procurement of the workforce (skilled & unskilled) for execution of various project activities, mobilization and transportation of construction machinery, working tools and equipment to the sites for the take-off of development activities;
- Mobilization and transportation of input materials for the take-off of development and construction works. This shall include gravel, sand, steel, timber, cement, reinforcement bars etc;
- Establishment of support facilities (i.e. site office, campsite, and store buildings, etc.) and
- Transportation of construction materials and equipment to the sites.

2.4.3 Construction Phase Activities

The nature of activities for both phases will be purely civil works, involving the construction of the facility buildings, construction of the TSF, and installation of the gold processing facilities. Activities during construction include:

- Clearing of site vegetation
- Borehole drilling and pumping
- Excavation works
- Masonry works (CIP plant, office etc)
- Construction of the TSF and WW ponds
- Installation of machines and equipment for gold processing
- Installation of fittings and furniture (for office, industry)

- Other activities will include rehabilitation of disturbed areas, and removal and disposal of generated waste materials

UDSM will apply for water use permit from the Lake Tanganyika Basin Water Board Office (LTBWB) before drilling the water borehole. Water availability surveys will be done prior the application of the permit.

The estimated duration of the construction phase is about 6 months, with a 1-year defect liability period (DLP).

2.4.4 Commissioning Phase Activities

In this phase, the contractors will hand over the buildings, and the infrastructure will be tested for technical aspects before operations commence. Suppliers of various equipment and machine will perform the installation of the machinery accompanied by additional technical assistance including process validation.

2.4.5 Demobilization Phase Activities

Demobilization activities will include removal of temporary structures (such as the campsite) and construction equipment. Rehabilitation of all disturbed working areas, and removal of soil stockpiles and construction wastes. The phase may take up to two (2) weeks.

2.4.6 Operation Phase Activities

The operation phase of the proposed CIP demonstration plant will include receiving of ore from the miners, ore processing, tailing disposal and water management. The operation phase will involve activities presented in Section 2.3.
following activities will take place:

2.4.7 Decommissioning Phase Activities

The decommissioning of the project may entail complete shutdown of the demonstration centre, change of use, or both. In case of shutdown of the plant, UDSM shall pull down the industrial establishment, remove all machines and equipment from the site, and restore the site. UDSM shall prepare a decommissioning plan (to be approved by NEMC or the Msalala DEMO) to guide the implementation of the activity.

2.5 THE DESIGN OF THE CIP DEMONSTRATION PLANT

Design of the proposed CIP demonstration plant took into account the current International and Tanzanian regulatory requirements and generally accepted "Good International Industrial Practice, GIIP" within the mining industry and also the World Bank Group's Environmental, Health and Safety (EHS) Guidelines

2.5.1 Design considerations

- **Ore characteristics**

The process plant design for the CIP plant was based on metallurgical test work results of several ore samples collected from ore rich sites in Mhandu, Mwazimba, E-unit Square, Kajuna Mine, Kalole, Nyangarata, Busulwangiri, Mwabomba, Mwime and Bumbiti in Msalala village.

The collected samples were subjected to comprehensive laboratory analysis to determine their mineralogy, grade, and metallurgical properties, which was aided in evaluating the economic viability of the deposit and selection of appropriate ore processing methods. The observed geological and mineralogical characteristics provided valuable insights into the proper processing method and design of the CIP plant.

- **Design of the CIP processing Plant**

The CIP processing plant will include a two-stage crushing circuit that will deliver the product to a stockpile or ball mill feed conveyor. The grinding circuit will involve a single stage grinding with ball mill closed with hydrocyclones that will generate an overflow P80 size of 106 µm. The underflow product from the hydrocyclones will be directed back to the ball mill for further grinding. When the treated ore contains higher content of coarse gold (i.e. nuggets), the ball mill discharge will be directly fed to the centrifugal concentrators in order to recover the coarse gold. The hydrocyclone overflow will flow by gravity to the leaching circuit which will consist of 15 tanks (i.e. 3 conventional tanks and 12 Pachuca tanks). A carbon safety screen will be installed at the last tank to serve carbon during offloading or from escaping to TSF in case of inter tank screen damage. The cyanidation tailings from the process plant will be detoxified before being pumped to the tailings storage facility (TSF).

The gold loaded carbon recovered from leaching process will be acid washed and stripped in elution column to generate a pregnant elute for the electrowinning process. The single 2-cathode electrowinning cell will be used to recover gold from the pregnant eluate.

- The design throughput rate of the demonstration CIP plant has been set at 10,950 tonnes per year.
- An effective utilization of 67% for the crushing circuit and 90% for the wet plant has been used for design purposes. These rates are based on the inclusion of an intermediate

crushed ore stockpile and installed standby pumps in critical areas of the process plant. Other key process design criteria for the plant are presented in the design report (UDSM, 2023). A summary of key design criteria is presented in Table 2.2 presents a summary of the designed plant parameters, while details on other design parameters and considerations, including climatic conditions adopted for design, carbon characteristics, leaching details and specific capacity of each pf the CIP plant is provided in Appendix 4.

Table 2-2: A summary of key design criteria for the CIP plant

Criteria	Units	Value	Source
Crushing			
ROM ore size (F80)	mm	200	UDSM
Design Crushing Rate	t/h	2	Vendor
Primary crusher product (P80)	mm	40	Calculated
Secondary crusher product (P80)	mm	5-15	Calculated
Crushing Circuit Utilisation	%	67	Calculated
Shifts per Day		2	Calculated
Hours per Shift	h	12	Calculated
Annual Operating Hours	h	5,869	Calculated
Milling and Classification			
Plant treatment capacity	t/a	7,300	NEMC
Days per Annum	days	328	Calculated
Hours per Day	h	24	Calculated
Plant Utilisation	%	90	Calculated
Annual Operating Hours	h	7,872	Calculated
Circuit Treatment Rate – Dry	t/h	2.0	Calculated
Grind Size P80	µm	100-106	Test Work
No of cyclone cluster		1	Test work
No of cyclones		2	Test work
Design volumetric flow rate	m3/h	8-15	Calculated
Cyclone diameter	mm	125	Calculated
No of operating cyclone		1	Calculated
Cyclone pressure, design	kPa	60-350	Vendor
CIP circuit			
Plant Feed Grade	g/t	6.0	Test work
Solids feed rate	t/h	2.0	Calculated
feed slurry density	%	45-50	Test work
Leaching recovery	%	88-90	Test work
Elution and Electrowinning			
Number of elution per week		3	Calculated
Carbon batch size	t	0.5-1	Calculated
Acid wash capacity	t	1.0	Calculated

Criteria	Units	Value	Source
Elution column capacity	t	1.0	Test Work
Bed volume	t	2.0	Calculated
Elution temperature	oC	90-120	UDSM
No of electrowinning cells		2	Calculated
Cell area	m2		Calculated
Total rectifier current required	amp	20	To be validated
Elution-Electrowinning cycle time	h	24	Calculated

Source: (UDSM Design report, 2024)

Table 2-3: Summary of the designed operating parameters for the CIP plant

Description		**Unit**	**2t/h (nominal)**	**3t/h (maximum)**
Carbon in Pulp (CIP)				
Operating life		years	20	20
Operating weeks per year		w/yr	52	52
Operating days per week		d/week	7	7
Operating hours per day		h/d	24	24
Shifts per day			3	3
Hours per shift			8	8
Plant availability		%	100	100
Operating hours per year		h	8,760	8,760
Design plant throughput		t/h	2.0	3.0
Feed Grade, design				
	Au av.	g/t	6	6.72
	Au	g/t	6.00	6.72
Leach extraction circuit, design	Au	%	88.0	90.0
Leach residue, design				
Tail solution grade, target	Au	g/m^3	≤0.01	≤0.01
CIP carbon adsorption, target	Au	%	99	99
Leach/adsorption/elution circuit design extractions	Au	g/t	5.27	6.04

(Source: UDSM Design report, 2023)

Equipment selections and specifications have been based upon test work results, vendor advice and experience. The layout of the plants has been optimized to improve operability, ease of maintenance, access and to minimise capital costs.

- **The Design of the Tailing Storage Facility (TSF)**

The Tailing Storage Facility (TSF) of the proposed project is a crucial component of mine infrastructure, it’s designed to safely contain and manage the waste materials generated during the mining process. Tailings shall be collected from the processing plant by a discharged pipe surrounding the embankments of the TSF, on sedimentation tailings shall be contained in the TSF while water shall be drained from the pond by a perforated decant tower to a storage tank and recycled back into the process plant. Furthermore, the TSF bottom and embankment will be lined with 300mm thick well-compacted clay soil, and an HDPE liner of 1.5mm thick will be installed throughout the TSF to prevent seepage of tailings to the environment. The design has included a free board as an allowance for the inflow of tailings, other design assumptions and specifications are shown in Table 2-3 and the working drawings are attached in Appendix IV.

Table 2-4 The TSF Design Specifications

SN	Item	Specification
1	TSF storage capacity	22,000m^3
2	Bottom area	70m x 70m
3	TSF slope embankments (upstream and downstream)	1:2 and 1:3
4	Mine plant throughput	20 Tonnes/day
5	Throughput per annum (Assuming 95% availability of plant)	6,935 Tonnes/year
6	Design Freeboard	0.5 m
7	Ore solid density	2.8 Tonnes/ m^3 with 45% solids
8	Density of the slurry	1.41 Tonnes/ m^3
9	Estimated Reservoir Volume (five-year design life before embankment rise)	22,132 m^3
10	Percentage Recovered water	10%
11	Starter dam height	5.0 m
12	Starter dam elevation above mean sea level	1252.50 m

- **The foundation designs**

The design of the CIP demonstration plant was proceeded by geotechnical investigations, to establish the requirements for the foundation design. The soil parameters established from a geotechnical site investigation determined the type and strength of foundation required.

- **Civil and Structural**

Civil and structural works were done in accordance with the relevant International and Tanzanian Standards, and GIIP. All bunded areas are suitably sloped for the duty to the area sumps which will be located to facilitate easy access. Site planning, including position of various project components has been done and is presented in the site layout plan in Figure 2-4.

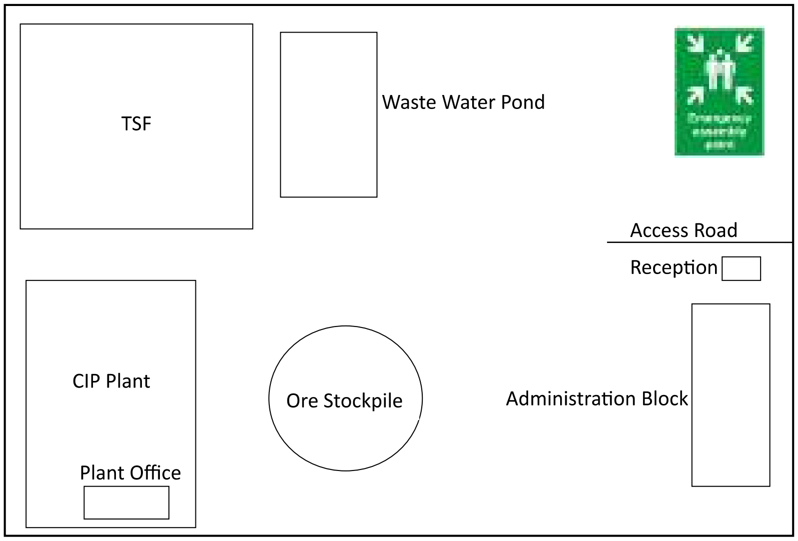


Figure 2-4: The proposed site layout, showing the arrangements of the project components

2.6 PROJECT REQUIREMENTS

2.6.1 Building materials

During construction, the project will require various standard construction and installation materials such as cement, sand, bricks/blocks, reinforcement bars, wood, roofing materials (iron sheets), aluminium and others. These materials will be stored onsite, in sealed containers as may be required. More details are presented in Table 2-1.

- Source of construction materials: Construction materials will be sourced locally in Shinyanga region. In case the selected contractor will get involved in extraction of construction materials, the IFC Environmental, Health, and Safety (EHS) guidelines for construction materials extraction shall be adhered to.
- Materials will be transported to the construction site by trucks.
- Water for use in construction will be pumped from the onsite borehole.

The quantity of the construction materials will be established after the preparation of the bills of Quantity (BoQ) is completed, and will be presented in the ESIA report.

2.6.2 Chemicals/ reagents and materials

The main chemicals and reagents needed for the project include Sodium Cyanide, Lime Activated carbon, Hydrogen peroxide, hydrochloric acid and Borax. Chemical management will be done in accordance to the specific material data sheet.

Sodium Cyanide: Cyanide use should be consistent with the principles and standards of practice of the International Cyanide Management.

Borax: Also known as sodium borate, is a common component of many detergents and has many household cleaning uses. It is classified as non-toxic, causes no known chronic health effects and is even found in some teeth-bleaching formulas. Studies have indicated that there are no health risks found to neither humans nor wildlife except in the most extreme scenarios involving direct consumption (Wang *et al*., 2009). Additionally, the study concluded that no acute or chronic health effects were associated with the use of borax. Negative effects included the potential for eye irritation when borax was not handled properly, but even this effect was mild and short-term. (Wang *et al*., 2009)

2.6.3 Equipment and Machinery Requirement

The following equipment will be used during the construction and operation phase of the project. Table 2.3 presents construction equipment, while Table 2-4 provided details of equipment for each unit process during the CIP plant operation phase.

Table 2-5: Requirements during the construction and operation phases

Requirement	Type	Source	Quantity
Raw materials	Gravel/fill material	Borrow Pits in Msalala/Kahama	25 m^3
	Hard stones	Quarry Sites in Msalala/Kahama	20 m^3
	Sand	Sand Pits in Msalala/Kahama	20 m^3
	Cement	Commercial in Msalala/Kahama	10 tons
	Timber	Commercial in Msalala/Kahama	1 ton
	Corrugated Iron sheets	Commercial in Msalala/Kahama	
	Water	On site borehole (to be established)	10 m^3
Energy	Electricity	TANESCO (National Grid)/ Generators	3500 kWH per month
	Fuel	Local vending stations	1000 L
Man power	Skilled	Contractor	Table 2-5
	Unskilled	Local people around the project area	Table 2-5
Equipment	Motor Graders	Contractor	1
	Vibration Roller	Contractor	1
	Bulldozers	Contractor	1
	Water Bowser	Contractor	1
	Excavators	Contractor	1
	Dump Trucks	Contractor	1
	Concrete Mixer	Contractor	1
	Water Pumps	Contractor	1

Source: (UDSM, 2023)

Table 2-6: Equipment Requirement for the operation of the facility

Sn	Unit Process	Equipment	Size	Capacity	Power	Quantity
1	**Crushing**	Grizzly Screen	150 x 150 mm			1
		Jaw Crusher	200 x 300 mm	5 - 11 t/h	11 KW	1
		FEL				
		Cone Crusher	2ft, Fine	3 - 5 t/h	22 Kw	1
		Single deck Screen		5 - 11 t/h		1
		Conveyor Belt		5 - 11 t/h		5
		Mill feed chute				1
		Stockpile		30 t		
2	**Grinding and Classification**	Ball mill	900 x 3000 mm	1- 3.5 t/h	30 KW	1
		Trommel Screen	0.6 x 0.6 mm			
		Hydrocyclone	125 mm (dC)	8 - 15 m^3/h		2
		Cyclone feed pump		10 - 22 m^3/h	7.5 KW	2
		Raw water tank		10 m^3		1
		Sump box				
		Centrifugal concentrator		1 t/h	1 KW	1
		VFD		50 Hz		10
3	Leaching Circuit	Tonnage box		1 m^3		1
		Process water tank		20 m^3		1
		Reagent Mixing tanks		100 L		2
		Reagent Mixing tanks		200 L		1
		Leaching tanks		12 m^3		3
		Leaching tanks		2 m^3		12
		Intertank Screen	23 x 24 cm	0.8 mm		12
		Intertank Screen		0.8 mm		3
		Agitators				3
		Carbon air Lifters				14
		Carbon recovery screen				1
		Carbon safety screen				1
		Air filter				1
		Air Piston Compressor				2
4	Detoxification	Detox tank		40 m^3		1
		Agitator				1
		Slurry pump		10 - 22 m^3/h	7.5 KW	2
		Reagent Mixing tank		200 L		1
		Feeding water tanks		1000 L		2

Sn	Unit Process	Equipment	Size	Capacity	Power	Quantity
5	Elution and Electrowinning	Elution Column		1 t		1
		Acid water Tank		500 L		1
		Transfer pump		5.8 m^3/h		2
		Heat Exchanger			3 KW	12
		Elecrowinning cell	90 x 90 cm	300 L		1
		Digestion Chamber	2.6 x 2.7 m			1
		Effluent u/g tank	2.37 x 2.37 x 3m			1
		Fume hood				1
		Smelting Furnace (Gas fired)		1200ºC		1
		Barren solution Tank (Cemented)	2.6 x 2.7 x 3 m			1

Source: (UDSM, 2024)

2.6.4 Utilities

i. Water Supply

It is certain, that the core operations of the project do require amount of water during operation process. Depending on hydro-geological environment the water table in the area falls between 70-100 metres, ground water through borehole will be used as a source for the proposed processing plant. Continual pumping of ground water from the small-scale mining pits observed during site reconnaissance survey conducted in July, signifies availability of water for the proposed gold processing plant (CIP) during dry season. The current practice with ASM is to pump water from the pits and discharged to the environment directly.

For the proposed plant, it is estimated that 5000 Litres of water will be used in every 20 tonnes of ore processed; and 35 Litres of water will be used per capital per day for domestic consumption. It has to be noted that gold processing water consumption may vary depending on the ore quantity and quality/grade. A 10 m^3 reservoirs has been designed for the plant,

ii. Energy

The Site visit noted the presence of erected power supply poles, connected to the National power grid line. The source of energy will be TANESCO. Power demand for the project is expected to be 3500 kWH per month to cover the processing plant, office and domestic uses. However, there will be a standby generator of 3.2 kVA to cover for power supply during power outage from the national grid.

iii. Communication and Transport

The corporation will use all mobile services available at the project site. Main transport means to the project site will be by road.

2.7 LABOUR REQUIREMENT AND MANAGEMENT

Labor management shall be accordance to local labor laws, the Occupation Health and Safety regulation and rules and the project ESMF (specifically the provisions of the WB ESS1 and ESS2).

2.7.1 Management of Contractors

UDSM shall adhere to guidelines of the ESS 1 on management of the contractors. ESS1 requires that the UDSM ensure that the Contractors engaged in the project operate in a manner consistent with the requirements of the ESSs, including the specific requirements set out in the Environmental and Social Commitment Plan (ESCP). The Borrower will manage all contractors in an effective manner, including:

(a) Assessing the environmental and social risks and impacts associated with such contracts;

(b) Ascertaining that contractors engaged in connection with the project are legitimate and reliable enterprises, and have knowledge and skills to perform their project tasks in accordance with their contractual commitments;

(c) Incorporating all relevant aspects of the ESCP into tender documents;

(d) Contractually requiring contractors to apply the relevant aspects of the ESCP and the relevant management tools, and including appropriate and effective non-compliance remedies;

(e) Monitoring contractor compliance with their contractual commitments; and

(f) In the case of subcontracting, requiring contractors to have equivalent arrangements with their subcontractors

2.7.2 Working conditions

The World Bank ESS2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. Workers in all construction projects are susceptible to unsafe or unhealthy working conditions that can lead to injury and illness, ranging from minor ailments to fatalities. The project will involve construction activity that is hazardous by its nature, including use of heavy equipment, loading and unloading of materials, use of vehicles, earthworks, and use of hazardous materials such as fuels, oils and chemicals. The community can benefit from employment opportunities from the project. Proper labour management is crucial for the sustainability of the project.

The Contractor will have contractual obligations to adhere to provisions of ESS2 and the Tanzania Occupational Safety and Health Regulation (*OSHA Act, 2003)*. Sound worker-management relationships will enhance the sustainability and providing safe and healthy working conditions. The workers will be provided with

- Work contracts (specifying among many other the salary, working hours and job prescription);
- Health education and check-ups
- Induction courses and toolbox meetings
- Appropriate working gears
- Workers must adhere to the Code of Conduct.

Skilled labour shall be sourced as per the required qualification. Unskilled labour will be sourced from the local community. The contractor(s) in collaboration with the local government authority will advertise job positions at the contractor's office and local government office. Priority will be given to the available local people.

2.7.3 The size of the labour force

The construction force will comprise of a team of experts (skilled) and non-skilled laborers as shown hereunder:

Table 2-7: Labour requirement

Sn	Labor	Source	Qquantity	
			Construction	**Operation**
1.	Skilled labor	Procured locally in Tanzania	40	20
2.	Non skilled labor	The local community		

Source (UDSM, 2023)

2.8 WASTE GENERATION AND MANAGEMENT

The IFC EHS Guidelines for mining describe the potential for mining industry to generate large volumes of waste. The guidelines require that structures such as waste dumps, tailing iimpoundments /dams, and containment facilities should be planned, designed, and operated such that geotechnical risks and environmental impacts are appropriately assessed and managed throughout the entire mine cycle. USDM shall ensure that the waste management strategy is in agreement with the guidelines, together with the requirements of solid waste management Act, 2007, and the WB ESS3, which set the requirements to address resource efficiency and pollution prevention and management.

The project will generate various waste types which have been grouped into construction related and non-construction related wastes. Construction related wastes are those generated directly from construction activities, while the later are those generated by associated activities (i.e. domestic activities taking place at the campsites).

2.8.1 Construction Phase wastes

i. Construction wastes

These will include damaged/broken and malfunctioned equipment and construction materials, such as rubble, concrete, pipes, aluminium, iron, wood, glass, plastics etc.

ii. Non construction waste

These will include both solid and liquid wastes, and can be hazardous and non-hazardous materials.

- **Domestic wastes**: Both liquid and solid domestic wastes are expected throughout the project life cycle. Domestic wastes will be in the campsites and office (i.e. rooms, kitchen & dining areas) and from sanitation facilities.
- **Liquid waste**: wastewater is expected from sanitation facilities. These will be collected into septic tank- soak away system at the campsite(s).

2.8.2 Operation Phase Waste

The most significant waste generating mining activities will likely occur during the operational phases, which require the movement of large amounts overburden and creation of rock waste and tailings. Operation phase wastes are:

- Domestic wastes and non-process wastes;
- Processing wastes such as leach pad wastes and tailings;
- Hazardous wastes, such as chemicals, contaminated chemical containers & packaging materials, waste oils;
- Workshop scraps; and
- Electronic wastes

For the purpose of providing best waste management options, the generated waste can be further classified as organic (decomposable) and inorganic (non-decomposable); and hazardous and non-hazardous wastes as shown in Table 2-4.

Table 2-8: Expected waste types, sources and composition during the project phases

SN	Waste type	Location & Source	Associated activity	Composition
1.0	**Liquid waste**			
1.1	Sullage (grey-water)	Operation of the kitchens, dining area	Food preparation Washing & cleaning	▪ Organic Contain chemicals from detergents used, oil and grease. has high BOD, COD, ammonia nitrogen
1.2	Sewage (black-water)	toilets	Operation of sanitation facilities, mainly toilets	▪ Organic

SN	Waste type	Location & Source	Associated activity	Composition
				High organic load contains chemical detergents and pathogens
1.4	Tailing water and tailings	Ore processing area	Ore processing	High concentration of cyanide
2.0	**Solid waste**			
	Biomass	Construction sites (during site clearing)	Cut/removed /uprooted vegetation)	Organic
2.1	Food wastes	Cafeteria, kitchen and dining areas at campsite	Food preparation, food serving & food storage	Organic and highly putrescible
2.2	Mixed (Office waste)	Typical office activities (papers, broken furniture, packaging materials)	Trash (paper, bottles, broken office furniture etc)	Organic and inorganic
2.3	Yard waste and litter	Site	Yard sweepings	Organics and plastics
3.0	**Hazardous waste**			
3.1	Chemicals, contaminated containers & scraps	CIP Workshop	Chemical containers, spills, spent/ expired paints and w/shop scraps	Mixed inorganic in nature
4.0	**Electronic waste**			
4.1	Electronic wastes	Office workshops, garage, residence	Old/faulty gadgets, damaged/broken/expired test equipment, printer cartridge etc	Inorganics (a variety of metal alloys and plastic)

The expected types, amounts and treatment/disposal of solid and liquid wastes during the project implementation phases are presented in Table 2-5 and 2-6.

Table 2-9: Estimates of solid wastes amounts and management during the project implementation

Sn	Waste Type	Source	Quantity/ Volume	Potential for material recovery	Proposed management Strategy
1.0	**Construction Phase**				
Solid waste					
1.1	Construction wastes (steel, concrete, brick, and/or	Civil & non civil construction activities	*1% - 10% of construction materials becomes waste*	Recycling of valuable fractions	-Sorting, separation and proper storage on site, -Recyclables to be collected by selected dealers.

Sn	Waste Type	Source	Quantity/ Volume	Potential for material recovery	Proposed management Strategy
	asphalt, cement bags)		*(Wang et al., 2004).*		-non recyclables to be disposed in designated area in Msalala
2.2	Office waste	Office activities (filling, paper works etc)	1-4 kg/day	High potential for recycling	-Sorting separation and proper storage on site, -to be sold to local collectors -remains to disposed in designated area in Msalala
2.3	Food wastes	Camps site(s) and office	12 kg/d *(based on generation rate of 0.3kg/c/d & labor size 40 people*	-Could be sorted for use as animal feed	disposed in designated area in Msalala
2.4	Yard wastes & litter	Yard sweeping	To be established	organic	Used on site as soil conditioner
	Hazardous Waste				
2.6	Garage and workshop wastes	Waste oils, grease, rugs and containers	5-10 L per month	None	-Stored in specialise containers on site, to be removed by subcontracted hazardous waste specialist/contractor
		Filters	1-5 kg per year	none	
		Waste tyres	4 - 20 tyres/ yr		
		Batteries	10 - 40 batteries/ yr		
2.7	Chemical contaminated soils	Oils and chemical spills	Not established	None	To be removed from the site and treated as hazardous waste as required by the law.
3. 0	**Operation Phase**				
3.1	Tailings	Gold Processing	To be established	non	Stored in the TSF (may be reprocessed)

****- Recycling C&D debris is highly recommended since it makes the construction industry a lot more sustainable.***

Table 2-10: Estimates of liquid wastes amounts and management during the project implementation

Sn	Waste Streams		Volumes estimated	Liquid waste management
1.0	Pre-construction and Construction Phase			
1.1	Camp site(s)	Sewage & sullage from sanitation facilities in the camp and offices	2,880 L/day (based on assumptions that 80% of water supplied becomes wastewater, and a per capital consumption of 90	-disposal in septic tanks-soak away systems -in case pits becomes full, they shall be emptied by cesspit empties, and disposed

Sn	Waste Streams		Volumes estimated	Liquid waste management
			l/c/d), and average of 40 workers	of in a nearby designated WWT Pond
1.2	Batch Plant	Spent water	100% recyclable	Recycled to the plant

2.8.3 On site waste management

Principles of integrated waste management will be followed, including prevention, minimization, reuse and recycling, and safe disposal.

2.8.3.1 Management of tailings and tailing water

Tailings from the CIP demonstration plant will be pumped into the TSF with storage capacity of 22,000 m^3 and embankment inner dimensions of 70 m x 70 m and height 4.5 m, designed to meet the IFC EHS Guidelines on mining. Tailing water will be recycled onsite.

2.8.3.2 Prevention of construction waste through careful material management

The project will strive to fulfill the objectives of the ESS3. One of the objectives of the ESS 3 is to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
The contractor will develop a site layout plan from better management of construction materials and prevention of damage. The Contractor will construct a storage system (i.e. sitestak system) that prevents drainage materials from going to waste. Securely storing materials in a SiteStak workstation protects them from damage, and it also provides a safe location to return excess materials as each part of the job is completed.

2.8.3.3 Prevention of domestic's waste

Domestics waste could be reduced by:

- Inclusion in the campsite design of facilities and services that will reduce the use of disposable products i.e. refill dispensers for soap, washable clothes, use of water filters vs disposable bottles etc).
- Making a conscious decision in buying of supplies
- Using reusable glasses, crockery and cutlery during the operation of the demonstration centre

2.8.3.4 Waste separation and storage

The contractor will be responsible for provision of waste storage facilities at the campsite. The contractor will design a waste management plan, outlining locations of waste collection bins or skip container. The contractor will be required to use standard colour-coding practice for waste streams to encourage the segregation of waste materials

2.8.4 Transportation of wastes

General wastes shall be transported from the plant to a designated disposal area within the Msalala DC. As per the IFC Guidelines on waste management, on-site and off-site transportation of waste shall be conducted in a manner that prevent or minimize spills, releases, and exposure to employees and the public. All waste containers designated for off-site shipment shall be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by documents (i.e., manifest) that describes the load and its associated hazards, consistent with the IFC guidelines.

Hazardous Wastes: Transportation of hazardous materials shall be done in accordance with the IFC guidelines (provided in Section 3.4) on the Transport of Hazardous Materials and the requirements of the Hazardous Waste Regulations (Part IV – In-Country Movements of Hazardous Waste). The procedures for transportation of hazardous materials shall adhere to local and international standards, and shall include:

- Use of suitable hazardous waste storage containers/packaging;
- Proper labelling of containers, including identity and quantity of the contents, hazards, and transporter contact information. The hazardous truck will also be labelled accordingly.
- Ensure documentation is properly done (availability of transporting document that describes the contents of the load and its associated hazards in addition to the labelling of the containers.
- The documents shall establish a chain-of-custody using multiple signed copies to show that the waste was properly stored, transported and received by the recycling or treatment/disposal facility.

2.8.4.1 Environmental and economic benefits of integrated waste management

Waste prevention, reuse and recycling will reduce the volumes of waste to be transported to the dumping area, resulting to

- Saving the dumpsite space
- Reducing land pollution
- Saving transport costs; and
- Reducing exhaust emissions, including greenhouse gases, (and consequently reducing the global warming potential of the project).

CHAPTER THREE

3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 INTRODUCTION

The implementation of mercury-free gold processing demonstration center will be guided by and need directives from various legislations. The project developer i.e. the UDSM must adhere and strictly comply with all the pertinent regulatory requirements including national and international requirements (i.e. the WB ESMF). The objective of this Chapter is to understand the key provisions of regulatory framework related to the environmental and social aspects of the proposed project activities.

3.1.1 The Constitution of Tanzania

The United Republic of Tanzania Constitution of 1977 (Amended from Time to Time) is the supreme law of the country and fits in the legal framework because it plays two major roles; first it is a grand norm, the instrument which all other laws of the country derive their legitimacy. That means, all the laws enacted in the country must conform to it and should not be inconsistent with the constitution. Therefore, all the laws enacted to regulate the construction industry and the mining sector in Tanzania derives their legitimacy from the constitution as provided in Article 64. -(1) which state that “Legislative power in relation to all Union Matters and also in relation to all other matters concerning Mainland Tanzania is hereby vested in Parliament”.

3.2 RELEVANT POLICIES

Tanzanian ministries and authorities issue policies that serve a variety of purposes, such as formulating visions and goals, defining strategies to achieve the goals and considering the development of administrative, legislative and managerial frameworks to achieve the goals of the plan or policy. The following are summaries of some of the policies that are or may be relevant to the project.

3.2.1 National Environmental Policy, 2021

The NEP provides the framework for incorporating and mainstreaming environmental and social considerations into decision-making in Tanzania. It is a comprehensive attempt to guide the conservation and management of natural resources and the environment and provides for cross-sectoral and sectoral policy guidelines, instruments for environmental policy, and the institutional arrangements for environmental management for determining priority actions and monitoring.

The policy stipulates that an EIA shall be mandatory for all major projects and those in ecologically sensitive areas to ensure that environmental concerns receive due and balanced consideration in reconciling urgent development needs and long-term environmental sustainability. The policy emphasizes that environmental considerations should not become an afterthought in planning and decision making; rather, it should be part of a conscious awareness of Tanzania’s development realities. The NEP places emphasis on public consultation as an effective tool in the EIA process. *This study abides to the NEP (2021) as required by the Tanzanian government. The minerals processing demonstration center will observe relevant requirements of the national environmental policy during the whole life cycle of the project.*

3.2.2 The Mineral Policy of Tanzania, 2009

The National Mineral Policy of Tanzania, 2009, recognizes the importance of integrating environmental and social concerns into mineral development programs as a way of ensuring mining sustainability. In order to achieve sustainable mining development, the policy underscores the need to balance the protection of flora and fauna its natural environment with the needs for social and economic development. It also recognizes that poor environmental management and poverty stricken living conditions that exist in small-scale mining camps are due to a lack of coordination, insufficient operation funds and inadequate expertise. In order to overcome these problems, the policy has emphasized on strategies which aim at reducing/eliminating adverse environmental effect of mining, improving health and safety conditions in mining areas, and focusing on social issues affecting women, children and the local communities. The policy has specific strategies for environmental management of small-scale mining and those for ensuring human health and safety during the mining operations. The Mineral Policy of Tanzania also deals with the environmental and social sustainability of mining developments and provides a framework of strategies for protecting the environment as well as ensuring human health and safety during mining. These include:

- Establishing environmental management programs;
- Complying with regulations and monitoring required by the Government;
- Carrying out baseline environmental studies and environmental impact assessments for new projects;
- Completing the required environmental audits;
- Ensuring environmental liability;
- Complying with guidelines restricting mining in certain areas (including forests, national parks and bodies of water);
- Preventing the use of toxic chemicals and associated pollution;
- Complying with any health and safety regulations;
- Preventing accidents and hazards to the health and safety of humans;
- Investing in health care facilities; and
- Incorporating provision for hygiene enhancing facilities including water supply and sewerage facilities.

The minerals processing demonstration center will ensure compliance with the provisions of this policy throughout the life cycle of the Project.

3.2.3 National Land Policy, 1997

The National Land Policy (1997) advocates the protection of land resources from degradation for sustainable development. The policy stipulates several environmental issues; of relevance to this Model mine project such as land use planning, taking into consideration the land capability, ensuring effective management of rural land resource. The policy also promotes resource sharing and multiple land use techniques in areas of conflicting land use, and advocates the involvement of communities in resource management, land use and conflict resolution.

The minerals processing demonstration center continues to observe relevant requirements of the National Land policy and will continue to observe such requirements during the whole life cycle of the project.

3.2.4 National Water Policies (NAWAPO), 2002

The main objective of the National Water Policy (NAWAPO, 2002) is to develop a comprehensive framework for sustainable development and management of the nation's water resources, and establishing an effective legal and institutional framework for its implementation (URT, 2002). The policy aims to ensure that beneficiaries participate fully in all stages of water resource developments. The NAWAPO recognizes the fundamental but intricate linkages between water and socioeconomic development, including environmental requirements. The policy expounds on the importance of water for domestic use, agriculture, livestock keeping, mining, energy, fisheries, environment, wildlife and tourism, forestry, navigation and trans-boundary requirements and calls for Integrated Water Resource Management in Tanzania to ensure "there is equitable and sustainable use and management of water resources for socio-economic development, and for maintenance of the environment" (URT, 2002). The minerals processing demonstration center is aware of the importance of the water policy elements and will adhere to policy notably in:

- Water use for basic human needs has the highest priority. Water to sustain the environment and other uses are subject to social and economic criteria, which shall be reviewed from time to time;
- The "Polluter Pays Principle" shall apply in conjunction with other legal and administrative actions;
- Standards for in-stream flows, industrial effluents and other waste discharges to be developed will be enforced;
- Water related activities should aim to enhance or to cause least detrimental effects on the natural environment;
- The allocation and consumption of water for environmental purposes is to be given appropriate considerations
- Water for environment shall be determined on the best scientific information available, considering both the temporal and spatial water requirements, to maintain the health and viability of riverine and estuary ecosystem;
- Status of surface and groundwater resources, in terms of quantity, quality and its use shall regularly be determined and information made easily accessible to stakeholders and decision makers.

Since the minerals processing demonstration center project area has no surface water, care will be taken by the Proponent during construction and operation on storm water and effluent not to contaminate environment in line with the above Policy.

3.2.5 Sustainable Industrial Development Policy, 1996

Section 3 of the Sustainable Industrial Development Policy (1996) refers to a sound environmental management that ensures promotion of environmentally friendly and ecologically sustainable industrial development. The policy underscores the importance of carrying out an EIA prior to undertaking any development project. Also, the Tanzanian Government aims to promote the continuous application of an integrated preventative environmental strategy including propagation of efficient use of raw materials and energy, elimination of toxic or dangerous materials as well as reduction of emissions and waste at source. The minerals processing demonstration center will ensure that the development and implementation of environmental management actions on site are in line with the provisions under this policy this is due to the fact that the proposed mining processing plant would require and emit energy on daily basis during running of its operations, use of chemicals whereby some are toxic and generate wastes.
The project will ensure that the development and implementation of environmental management actions are in line with the provisions of this policy

3.2.6 The National Investment Promotion Policy, 1996

The National Investment Promotion Policy seeks to promote the growth of exports by strategically utilizing the scarce natural, social and capital resources to accomplish national development. A key factor of this policy is the promotion of exports emanating from domestically produced goods and services in order to enhance development of a dynamic and competitive export sector. In order to achieve this objective, the policy encourages all investments to be accompanied by strategies aiming to increase export production and promoting and encouraging minerals beneficiations in order to minimize valuable minerals in waste and increase production and quality. Being production cum training centre.
The minerals processing demonstration center shall strive to ensure that its operations contribute to the growth of the export sector and value added mineral products in Tanzania.

3.2.7 Tanzania Women and Gender Policy (2000)

The overall objective of the Gender and Development Policy is to promote gender equality and equal participation of men and women through facilitation of access to education, child care, and employment and decision making. The proposed project will employ some workers on merit base.
The minerals processing demonstration center will work in line with this Policy in order to promote gender equality and equal participation of men and women in all matters wherever possible and within the armpit of this policy.

3.2.8 National Forest Policy, 1998

The National Forest Policy (1998) identifies four main policy areas (forest land management; forest based industries and products; ecosystem conservation and management; and institutions and human resources), and presents policy statements and instruments/directives to be applied to each area. In accordance with the policy, an ESIA is required for all investments which would convert forest land into other land uses, or may cause damage to the forest environment. The policy feature which is relevant to the proposed project is

- Biodiversity conservation and management as well as watershed management and soil conservation will be included in the management plans for all forests and
- Involvement of local communities and other stakeholders in conservation will be encouraged.

The minerals processing demonstration center will work in line with the requirements of the National Forestry Policy in order to minimize any potential impacts.

3.2.9 The Wildlife Policy, 1998

The Wildlife Policy (1998) aims at providing management frameworks for wildlife and their ecosystems through participation of communities and private sector. Communities are trained to develop skills and knowledge concerning wildlife management through awareness and capacity building campaigns. Likewise, the participation of the private sector is achieved by ensuring that EIAs are undertaken for all projects located in protected areas. Through environmental studies, the development and implementation of management plans as a way of mitigating socio-economic and environmental adverse impacts are ensured. The policy provides mechanisms that ensure the development of projects in protected areas are carried out without compromising the biodiversity. *In undertaking the study, the project has observed the requirements of the Wildlife Policy and will abide throughout the life cycle of the project.*

3.2.10 The National Health Policy, 2003

The National Health Policy is aimed at providing direction towards improvement and sustainability of health status of all people by reducing disability, mobility and morbidity, improving nutritional status and raising life expectancy. The objectives of the policy among others include reduction of the burden of disease, maternal and infant mortality, and increase life expectancy through the provisions of adequate and equitable services. Furthermore the policy aims at facilitating the promotion of environmental health and sanitation, adequate nutrition, control of communicable diseases and treatment of common conditions. The policy also emphasizes on enhancement of environmental cleanliness, monitoring of food and water quality and the safety achieved through collaboration with other stakeholders.
The proposed project will adhere to these policy requirements to ensure no transmission of such communicable diseases between workers and the community, protect workers from all sorts of health risks and hazards. The minerals processing demonstration center project will also facilitate the availability of adequate and equitable services in support of health programs.

3.2.11 National HIV/AIDS Policy 2001;

The policy provides the framework, direction and general principles of the national response interventions for the prevention, care and support of those infected and affected by the human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) and mitigation of their impact. The relevant objectives of the policy are to prevent transmission of HIV and AIDS, provide HIV and AIDS voluntary testing with pre-and post-test counselling, and care for people living with HIV and AIDS (PLHAS).

The policy also provides for Creating a legal framework through enactment of laws on HIV/AIDS-governing ethical issues and legal status of HIV/AIDS affected families, Strengthen the role of all the sectors, public, private, nongovernmental organizations, faith groups, PLHAs, community-based organisations and other specific groups to ensure that all stakeholders are actively involved in HIV and AIDS work, and provide a framework for coordination and collaboration.

Mobilization of project workforce, interaction between the workforce and local communities and project induced in migration may increase incidence of sexually transmitted diseases such as HIV/AIDS Community and worker health and project induced in-migration impacts have been assessed and mitigation measures developed. These will be included in management plans for occupational and community health and safety.

3.2.12 Occupational Health and Safety Policy 2009

The policy provides for Promotion of Occupational Health and Safety encompassing provision and maintenance at the highest degree of safe and healthy working conditions and environment. This is a prerequisite for the facilitation of optimal social, mental and physical wellbeing of workers at workplaces as well as safety of property. The policy also aims to reduce the number of work-related accidents and diseases in Tanzania through adoption and implementation of a culture to prevent OHS hazards by Government, Employers and Employees. The effective prevention of work - related accidents and ill- health will have enormous social and economic benefits. These include improvements in productivity and competitiveness and the quality of life of the working population. The effective management of many safety hazards will contribute to improved levels of public health and safety. The effective control at source in workplaces of hazardous substances by improve levels of public health and minimize environmental pollution.

The proposed mineral processing demonstration center project shall adhere to the policy through provision and maintenance at the highest degree of safe and healthy working conditions and environment

3.2.13 Human Resources Policy 2004;

The policy demonstrates the commitment of any developer to implementing best practices in human resource recruitment, training, and management. It also ensures that the rights of its employees are respected, and national employment laws are adhered to. In addition, endeavors to make sure that its employees maintain high levels of interest and motivation in the workplace. Providing opportunities for its employees to further their skills and offers a clear path for staff to progress in their career within the company. The policy also require the developer to:-

- Making employment decisions based on merit
- Supplying a legal contract to all employees stating Name, age, permanent address and sex of the employee, Place of recruitment, Job description, Date of commencement, Form and duration of the contract, Place of work, Hours of work, Remuneration, the method of its calculation, and details of any benefits or payments in kind and any other prescribed matter
- Paying fair wages to its employees
- Having clear disciplinary and employment termination procedures.

- Respecting work and rest times.
- Ensuring that training needs of staff are met.
- Ensuring the comfort and safety of employees at the workplace
- Respecting and inviting employees' ideas and input.
- Respecting employees' rights to Freedom of Association.

The proposed mineral processing demonstration center project shall adhere to the policy through to implementing best practices in human resource recruitment, training and management

3.3 PRINCIPAL LEGISLATIONS AND REGULATIONS

EIA studies are mandatory for all projects applying for mining or special mining licenses in accordance with the Mining Act, 2010 and its associated regulations. The Environmental Management Act, 2004, also requires all mining projects to conduct an EIA prior to commencement of any operations. The procedures to conduct an EIA are set out in the Environmental Impact Assessment and Audit Regulations, 2005. Other legislations relevant to a mining project include:

- The Mining Act (No.14) 2010 as amended in 2017 and Mining (Safety, Occupational Health and Environmental Protection) Regulations, 2010;
- The Water Supply and Sanitation Act (No.12), 2009;
- The Water Resources Management Act (No.11), 2009;
- The Energy and Water Utilities Regulatory Authority (EWURA) Act, (No.11) of 2001;
- The Forest Act (No. 14), 2002;
- The National land use Planning Act (No.6), 2007;
- The Land Act (No.4), 1999;
- The Village Land Act (No. 5), 1999;
- The Village planning and Regulation Act (No.58), 2007;
- The Wildlife Conservation Act (No.5), 2009;
- The Occupational Health and Safety Act (No. 4), 2003;
- The Prevention and Control of HIV/AIDS Act (No.28), 2008;
- The Industrial and Consumer Chemicals (Management and Control) Act (No. 3), 2003;
- The Tanzania Explosive Act Cap 45 R.E of 2002;
- The Employment and Labour Relations Act (No. 6), 2004;
- The Workers Compensation Act (No. 20), 2008;
- The Tanzania Atomic Energy Act (No. 7), 2003; and
- The Occupational Health and Safety Act (No 5)2003

3.3.1 The Environmental Management Act, (No. 20), 2004

This is a framework legislation governing environmental aspects in Tanzania. It includes provisions for sustainable management of the environment, prevention and control of pollution, environmental quality standards, public participation, and the basis for the implementation of international environmental agreements. The Act sets out the mandates of various actors to undertake enforcement and exercise general supervision and coordination matters relating to the environment. The EMA has established environment units in all ministries and environmental committees at the regional, district and village levels. Within each ministry, it is the Environmental Section's responsibility to ensure that environmental concerns are integrated into the ministry's developmental planning and project implementation in a way that protects the environment. It requires project developers to develop and implement Environmental Management Plans (EMP) as well as monitor any identified environmental issues associated with their project.

The Act is presented in 20 parts, each dealing with specific provisions of environmental management (not all of which are applicable to this project, but included here for the sake of completeness). The general principles for management and duty to protect the environment are provided in Part II, sections 4 - 10. In this part, the Act underscores the right of every person living in Tanzania to a clean, safe and healthy environment and the right of access to various public elements or segments of the environment for recreational, educational, health, cultural, spiritual and economic purposes. The administration and institutional arrangements are presented in Part III of the Act, sections 11 – 41. This part describes the powers of the Minister responsible for the environment and establishes the administrative structures and functions. Within the administrative structures, it establishes the NEMC and its functions, composition and powers. The Act also establishes structures, functions and duties in other ministries, regional, district and local government levels. The importance of environmental planning at all levels from local authority to national level is underscored in Part IV of the Act.

The provisions for the declaration of protected areas, environmental protection, ecosystem management plans and the identification and declaration of environmentally sensitive areas are given in Part V of the Act. The declaration of protected rivers, riverbanks, lakes or lakeshores, wetlands, the prohibition of human activities in certain areas and protection of mountains, hills and landscapes are described in this part of the Act. This part also deals with the protection of the coastal zone, gives the environmental obligations under water laws, issuance of directives and permits for the discharge of sewerage and effluents, management of forest resources and the promotion of conservation of energy and planting of trees. The promotion of the conservation of fisheries and wildlife, conservation of biological diversity, regulation of development, handling and use of genetically modified organisms and products has also been described in this section. This part also deals with the management of rangelands, environmental land use planning directives, protection of natural and cultural heritage, protection of the atmosphere, climate change, management of dangerous materials and processes, regulation of persistent organic pollutants, promotion of cleaner technology and economic incentives and instruments for the protection of the environment.

In Part VI, ESIA and other types of environmental assessment have been described. This section allows the Minister to make regulations and guidelines on how an ESIA shall be conducted and requires the assessment to be conducted by experts registered by the Council. The Environmental Impact Assessment and Audit Regulations 2005, made under this act, describe the procedures for carrying out an ESIA and Audit. Part VII of the Act puts in place a new legislative device for strategic Environmental Assessment. The measures for pollution prevention and control are provided in Part VIII of the Act. It elaborates the provisions prohibiting pollution and the powers of the Minister to make regulations to prevent and control pollution. Part IX addresses waste management and stipulates the duties of the local governments with regard to waste management.

The provision to set environmental quality standards has been assigned to the Tanzania Bureau of Standards (TBS) in Part X of the Act. It requires every person undertaking any activity to comply with the environmental quality standards and criteria. Environmental restoration, easements and conservation orders are provided for in Part XI. The Act also provides for (Part XII) the designation of laboratories for the purpose of analysis, and analysts and reference analysts for the purposes of taking samples and analysis in order to ensure that environmental quality standards are observed and enforced. In accordance with Part XIII, every citizen of Tanzania has a freedom of access to publicly held information on environmental management. The right of the public to participate in decision-making, the design of environmental policies, strategies, plans and programs as well as to participate in the preparation of laws and regulations relating to the environment is provided for in Part XIV. International agreements concerning the management of the environment are discussed in Part XV. This includes initiation of discussion with neighboring countries on environmental management measures and programs aimed at avoiding and minimizing trans-boundary environmental impacts.

Compliance and enforcement of relevant environmental management provisions, inclusive of the appointment of inspectors, their functions and powers are provided for in Part XVI. This part also provides for powers to issue and serve prevention orders to protect the environment, protection orders against activities adverse on the environment, emergency environmental protection orders and environmental compliance orders all of which are aimed at the prevention or minimization of harm to the environment.

The Act establishes (Part XVII) the “Environmental Appeals Tribunal to deal with appeals by persons who are not satisfied with any decisions made in relation to management of the environment”. A National Environmental Trust Fund that shall be used to meet various costs related to capacity building, offer awards, publications and promote research and promote community based environmental management programs, is established in Part XVIII. The financial provisions associated with environmental management as stipulated under the Act are provided for in Part XIX. Part XX provides for the general and transitional provisions of the Act.

The Act provides four Schedules with the first schedule describing the composition, meeting and procedures of the National Environmental Advisory Committee. The second schedule describes the procedure for conducting business by the Board, while the third schedule describes the types of projects that require an EIA. The fourth Schedule makes provision for the composition and proceedings of the Board of Trustees of the Fund.

The EMA is the major piece of legislation governing the management of the environment in Tanzania. The production of gold from ore has the potential to cause some environmental impacts such as deterioration of air quality, noise and land disturbance etc., As such the minerals processing demonstration center will observe and abide to all the provisions of this Act.

3.3.2 Environmental Impact Assessment and Audit Regulations No. 349 of 2005 as amended in 2018

The EIA process is described under the Environmental Impact Assessment and Audit Regulations GN No. 349 of 2005 (and amendment GN 474 of 2018) (‘the EIA Regulations’) promulgated in terms of the EMA Sections 82(1) and 230(2) (h) and (q). The regulations provide the procedures and requirements for undertaking ESlA for various types of development projects with significant environmental impacts. In addition, the Regulations provide a list of projects that qualify for

Environmental Assessment procedures in Tanzania. Regulation 4 Part III classifies projects into four types:

- Type A Projects requiring a mandatory ESlA,
- Type B1- Borderline projects.
- Type B2 -Projects that are no mandatory and Special Projects category.

The EMA guides environmental management and is administrated by the National Environmental Advisory Committee, the Directorate of Environment and the NEMC.
The proposed minerals processing demonstration center falls under Type A projects that requires full ESIA. At the end of the ESIA process an environmental certificate is issues by the Minister responsible for environment.

3.3.3 The Mining Act (No. 14), 2010 as amended in 2017

The Mining Act (Act No. 14 of 2010) as amended in 2017. A number of subsidiary legislation made under the repealed Act do however continue, as do all granted mineral rights, licenses, permits and authorizations. Section 5 of the Mining Act, vests the entire property in, and control over minerals in any land, to the United Republic of Tanzania. The Mining Act is the principal Act controlling all minerals extraction in the country and hence the minerals processing demonstration center abides by all provisions of this Act and its associated Regulations.
Regulations detail maximum areas on which a particular license (prospecting, special mining or mining) can be granted. The licenses normally do not cover surface rights although the Mining Act limits the rights of the third parties over surface rights in a licensed area. In case third party surface rights interfere with production, the Mining Act allows the license holder to remove third parties after compensation of the affected parties.
The holder of a ML is mandated to keep records of all operations in the mining area, including the implementation of his environmental management plan, copies of all maps, and geological reports, financial records of operations in the mining area, records of the production of minerals from the mining area; records of the number of persons employed by the holder in the mining area and the capacity in which they are employed. These reports are to be submitted within the first month of every calendar quarter to the Minister. In addition, every annual financial report will be submitted to the Minister within three months of the end of each financial year.
The area of land subject to the mining right shall be pegged and demarcated by erecting a post, securely placed in the ground at each corner of the relevant area. Each post must project not less than 2 m from the ground, indicate the owner of the land, type of mineral right with the licence number and state the dimensions and area covered under the license. The holder of a mineral right must maintain, in all posts, boundary indicator markers such as trenches and notices to indicate the direction of the boundaries of the license area. Any person who contravenes these regulations shall be guilty of an offence.
Since the minerals processing demonstration center project is directly involved in processing of gold ore it will comply with all the provisions of the Act which is the principal legislation for all mining activities in the country.

3.3.4 The Land Legislations

The administration, use, planning and development of land resources in Tanzania are regulated through The Land Act (No. 4), 1999, The Village Land Act (No. 7), 1999, The National Land Use Planning Act (No.6), 2007 and Village Planning and Regulations Act (No. 58), 2007. The acts are discussed separately in the following sections.

The Land Act Cap.113 R.E. 2002

The major function of the Land Act is to promote the fundamentals of the National Land Policy by giving clear classification and tenure of land, land administration procedures, rights and incidents of land occupation, granted rights of occupancy, conversion of interests in land, dispositions affecting land, land leases, mortgaging of land, easements and analogous rights, co-occupation and partitioning and, settlement of land disputes. One of the pertinent issues when dealing with land is the right of occupancy. According to the Land Act, 1999, the right of occupancy is given in two categories that separate citizens and non-citizens rights to occupy land:

- For a citizen, or in a group of two or more formed in an association, a partnership or corporate body will be granted the right of occupancy or derivative of a granted right of occupancy.
- For a non-citizen, or in a group whether formed into a corporate body under the Companies Ordinance or otherwise (including corporate bodies whose majority shareholders or owners are non-citizens), they may only obtain a right of occupancy or derivative right for purposes of investment prescribed under the Tanzania Investment Act 1997.

These sections are regarded crucial as the project provides investments that need to comply with the requirements of both the investment and land legislation. In ensuring harmony with other land users in the area, the minerals processing demonstration center will observe the provisions of the Act and its regulations.

The Village Land Act (No.5), 1999

The Village Land Act, (No. 5), 1999 was enacted specifically for the administration and management of land in villages. Under the provisions of this Act, the village council is responsible for the management of the village land and is empowered to do so in accordance with the principles of a trustee managing property on behalf of a beneficiary. As provided under Section 8 of the Act, the village council is required to manage land by upholding the principles of sustainable development, relationship between land uses, other natural resources and the environment. In so doing, the council exercises any of the functions of the management of the village land. A district council, as provided under Section 9 of the Act, may provide advice and guidance concerning the administration of the village land. In the case of a conflict over village land boundaries between a village and another person of body regarding, the Minister responsible may appoint a mediator or appoint an inquiry as provided under Section 18 of the Land Act, 1999.

Under the Act, the village council may grant derivative rights where an application has been made to the village council accompanied by a plan of location, boundaries and fees. For application of not more than 5 ha and for five years or less, known as Class A, it is determined by the council. For land of more than 5 ha, but less than 30 ha or Class B, it is determined by the council with the approval given by the village assembly. For Class C land or land of more than 30 ha for more than 10 years, it is determined by the council subject to approval by the village assembly and the advice of the Commissioner.

The proposed project area is within Bumva village, and management of land within this villages is under the jurisdiction of the Village Land Act and hence the importance of the knowledge of this legislation.

The Village Planning and Regulation Act (No.58), 2007

The Village Planning and Regulations Act, (No. 58), 2007 was enacted specifically for the orderly and sustainable development of land in village areas in order to preserve and improve amenities, to provide for the grant of consent to develop land and power of control over the use of land and to provide for other related matters administration and management of land in villages. Under the provisions of this act, the village council is responsible for the management of the village land and is empowered to do so in accordance to the principles of a trustee managing property on behalf of a beneficiary. In addition, the village council is required to manage land by upholding the principles of sustainable development, relationship between land uses, other natural resources and the environment.

Section 3 of the Village Planning and Regulations Act (No. 8), 2007, outlines fundamental principles of village planning, including improvement of infrastructure, employment, environmental management, and enhancement of land use planning. Section 4 of the Act delineates the main objectives of the Act as:

- Facilitate efficient and orderly management of land use.
- Empower land holders and users to make better and more productive use of their land.
- Promote sustainable land use practices.
- Ensure security and equity in access of land resource.
- Ensure public participation in repartition and implementation of land use policies and plans.
- Facilitate the establishment of framework for prevention land use conflicts.
- Facilitate the overall macro-level planning while taking into account regional and sectoral considerations.
- Provide for inter-sectoral coordination at all level.
- Ensure the use of political and educational structure and resource available at national, district and village levels.
- Provide a framework for the incorporation of such relevant principles contained in the national and structure development policies as may, from time to time be defined by the government.

In section 29, the Act details conditions to be followed in applying for planning consent. Accordingly, no development may be undertaken without the consent of the authority and the issuance of a license for any development in land planning. In additional an EIA report shall be submitted. Further, Section 32 of the Act details the application for the planning consent to develop land, which can be issued by the planning authority or director. Section 33 (1) and (2) detail the validity of planning consent and power of planning authority to revive the consent if necessary. Sections 46 and 47 of the Act provides information on development charges and rates, and power of the Director of Planning Authority against the consent provision for charge defaulters as well as appealing condition for the client dissatisfied with such rates.

In section 50, 51(1) and 52 (8) information is provided on classification of the conservation areas and appropriate conditions for carrying out the development in conserved area. Section 63 states that the value of any land within a planning area shall, for the purpose of determining the amount of compensation payable, are calculated in accordance with the provisions of the Land Act. In Section 67 it is stated that the compensation under this section shall be paid as provided for under the Land and the Village Land Act.

Since the project is located within Bumva village; it requires a sound land use planning. As such the minerals processing demonstration center will work in line with this Act during planning.

The National Land Use Planning Act (No.6), 2007

The National Land Use Planning Act, (No. 6), 2007, established the National Land Use Planning Commission. The Commission is the principal advisory organ of the Government on all matters related to land use and it is responsible for:

Policy formulation on land use planning matters.

- Evaluation of existing and proposed policies and activities of the Government directed to safeguarding of land against its wrongful, wasteful or premature use or development.
- Recommending policies and programs that will achieve more effective protection and enhancement of the land quality and encourage better land use planning.
- Recommending measures to ensure that Government policies including those for the development and conservation of land take adequate account of its on land use.

Due to the locations of the proposed Project, the areas surrounding the project area may find themselves in land conflicts that may be as a result of inhabitants living in the area. The minerals processing demonstration center will seek to harmonize its land use with those of its neighbors through the provisions of the land use planning legislation.

3.3.5 The Tanzania Explosive Act Cap 45 R.E of 2002;

This act make provisions for the control of the manufacture, import, export, sale, possession and use of explosives, and for related matters. Part II provides for Manufacture of explosives prohibition except under license or permit Act No. 9 of 2002, Part III general responsibilities for the care and security of explosives though appointing persons to be in charge of explosives and provides for his/her responsibilities in prohibition of dangerous acts, smoking etc. Part IV provides for importation of explosives whereby no importation shall be allowed without a permit, the responsibilities of Port Management and forms of packing to be approved. Part V provides for transportation of explosives by restricting transportation of explosives without permits, general provision relating to care of explosives in transit and conveyance of explosive by boat. Part VI provides for acquisition, possession and disposal of explosives. Meanwhile part VII provides for storage of explosives as it provides guidance for general provisions relating to storage of explosives, report to be made of thefts, underground storage and permit for erection of magazine. Part VIII provides for use of explosives in relation to person in charge of explosives issued for use, blasting operations to be performed by holder of a certificate, blasting operations to be in charge of holder of certificate, blasting certificate and Persons responsible for observing provisions of this Part. Part IX provides for Procedure in case of accident and Inquiry into cause of accident Act No. 9 of 2002. Part X provides for power of inspectors, Power of police officer and Inspector may issue orders, lastly part XI provides for Notice to be given when works containing explosives are

closed down, offences, General penalty Act No. 9 of 2002, Onus of proof, Revocation of permits, Licenses, permits, ect., not transferable and regulation.
The proposed mineral processing demonstration center project shall involve the importation and transportation of explosives, hence guidelines stipulated from the act shall be adhered.

3.3.6 The Tanzania Atomic Energy Act (No. 7), 2003;

The act establishes Tanzania Atomic Energy Commission and provides for its functions in relation to control of use of ionizing and non-ionizing radiation sources, and the promotion of safe and peaceful use of atomic energy and nuclear technology. The Act consists of 79 sections divided into 12 Parts: Preliminary (I); The Tanzania Atomic Energy Commission (II); Control of the use of ionizing radiation sources and installations (III); Control of radioactivity in foodstuffs (IV); Radiation protection, physical protection, nuclear safety, radioactive waste management and emergency preparedness (V); The control of radiation exposure from natural sources (VI); The control of devices producing non ionizing radiation (VII); The promotion of atomic energy and nuclear technology (VIII); The operations of the Commission relating to radiation protection services (IX); Financial resources of the Commission (X); Miscellaneous provisions (XI); Consequential and transitional provisions (XII).
This Act provides its application to Mainland Tanzania as well as Tanzania Zanzibar in respect of all persons or body of persons whose undertakings involve or include generally the use of atomic energy and nuclear technology and in particular the production, processing, handling, use, holding, possessing, storage, transport and disposal of natural and artificial radioactive materials and radiation devices in respect of any other activity which involves a risk or harm arising from radiation (sect. 3). Section 4 further defines the application sphere of the Act. The Tanzania Atomic Energy Commission is established under section 5 and its functions are set out in section 6. The provisions of Part IV shall be read together with the Tanzania Food, Drugs and Cosmetics Act, 2003. The Commission shall, in consultation with the Tanzania Food and Drugs Authority and competent institutions, establish a system designated for the control of radioactivity in foodstuffs (sect. 29). Manufacturers of importers or exporters of food specified in Regulations shall obtain a radioactivity analysis certificate in respect of food distributed for human and animal consumption (sect. 30). Accumulation of radioactive waste on premises for further disposal requires an authorization of the Commission (sect. 33). Before granting its authorization, the Commission shall consult with local authorities, water utilization, river basin or other public authorities as appear proper (sect. 35).
The proposed mineral processing demonstration center project will seek to adhere to the act requirement so as to ensure safety of the environment.

3.3.7 The Industrial and Consumable Chemicals (Management and Control) Act (No.3), 2003

The mining industry is one of the major consumers of industrial and consumer chemicals that are regulated by this Act. All users, producers and marketers of industrial and consumer chemicals are required to register all chemicals imported, exported or produced in Tanzania with the Chief Government Chemist. An application for registration of the chemical shall be submitted to the

Chief Government Chemist in the prescribed manner and form. The Act establishes various committees such as the Industrial and Consumer Chemical Management Control Technical Committee and the Ministerial Advisory Board. The Act further prescribes procedures for obtaining approval for importation, registration, and general requirement for handling, storing, and warehousing chemicals. It also provides some restrictions on use, disposal of, importation and handling certain types of chemicals. The Act defines and lists chemicals which are highly hazardous and precursor chemicals. The decommissioning of the plant should be stated clearly to the Government and community affected, to provide precautions to ensure that harm to human health and the environment is prevented. In such steps and precautions there must be an EIA to ensure that all remaining stocks of chemicals are disposed of soundly.
As one of the users of chemicals, the project will operate and abide to provisions of this Act governing transportation, management, handling and use of chemicals.

3.3.8 The Water Resources Management Act (No.11), 2009

This legislation has repealed the Water Utilization (Control and Regulation) Act (1994). The Act underscores the institutional and legal framework for sustainable management and development of water resources; outlines principles for Water Resources Management; principles for prevention and control of water pollution and provides for participation of stakeholders and the general public in implementation of the National Water Policy, and plans and processes for the management of the environment. The main objectives are to ensure that the National Water Resources are protected, used, developed, conserved, managed and controlled in a way that meets the basic human needs of present and future generations, prevent and control pollution of water resources and protects biological diversity in aquatic ecosystem. In accordance with this law, all water resources in mainland Tanzania shall continue to be public water and vested in the President as the trustee for and on behalf of the citizens. The power to confer a right to the use of water from any water resources is vested in the Minister responsible for water.
However, section 9 of this Act, requires carrying out an EIA for any development in water resources areas. This ESIA is in line with this legal requirement. This Act applies to a development proposed in water resources area or watershed. Whether that development is proposed by, or is to be implemented by a person, organisation in the public or private sector, they shall carry out EIA in accordance with the provisions under this Act.
Section 43, stipulates the issue of application for a water use permit for diversion, dams, stores, abstract and uses of water from surface and/or ground water sources. The permit application condition limits the cause or allowance of any water to be polluted, prevent any damage to the sources, ensure sustainable use of water and submit any data on request by the Basin Water Board. According to section 63(1) "a person who wishes to discharge effluents from any commercial, industrial, or agricultural source or from any sewage works or trade waste systems or from any other source into the surface water or to underground strata shall apply to the Basin Water Board for a Discharge Permit in accordance to this Act; (2) The application for Discharge Permit shall be made in accordance with section 75 of this Act". Furthermore, WRMA in section 64(1-2) and 64(1-6) detail the issue of ‘‘discharge permits’’ which should be followed accordingly, in Section 86 of this Act, "Dam safety and flood management’’ should be taken care of. A "dam with safety risk" means any dam which can contain, store or dam more than 50,000 cubic metres of water, whether that dam contains any substance or not, and which have a wall of vertical height of more

than five metres, measured as the vertical difference between the lowest downstream ground elevation on the outside of the dam wall, and the non-overspill crest level or the general top level of the dam wall. WRMA insists on ensuring no blockage of watercourses in section 87(1) that, no person shall engage in any construction activity that blocks or otherwise impedes the flow of water in watercourse unless a permit authorizing the activity has been obtained in accordance with the provision of Part VII of this Act.

According to this Act in Section 103, any persons who pollute water in any water body and cause any impact to the environment shall be liable for conviction of a fine of not less than one million shillings, and not more than ten million shillings, or to imprisonment for a term of not less than six months, but not more than two years, or to both. In the case of subsequent conviction, a fine exceeding five million shillings or to imprisonment for term not exceeding two years or to both will be applied. In the case of continuation of the offence, an additional fine not exceeding fifty thousand shillings in respect of every day during the offence continues will be applied.

As the Project is located to an area without surface water except for water storm, but underground water is available so to ensure the environmental sustainability of water resources, the project will strive to comply with the provisions of the Water Resource Management Act, 2009.

3.3.9 The Water Supply and Sanitation Act (No.12), 2009

This legislation provides for sustainable management and adequate operation and transparent regulation of water supply and sanitation services; provides for establishment of water supply and sanitation authority as well as community owned water supply organizations; and provides for appointments for service providers. The main aim of this legislation is to ensure the right of every Tanzanian to have access to efficient, effective and sustainable water supply and sanitation services for all purposes by taking into account the production and conservation of water resources, development and promotion of public health and sanitation; and protection of the interest of customers. Under this Act, the Minister responsible for water affairs shall establish water authorities and cluster water authorities in order to achieve commercial viabilities.

The minerals processing demonstration center recognizes the public health importance of water and sanitation in work places. Therefore the Water and Sanitation Act will be complied with during project life time.

3.3.10 The Energy and Water Utilities Regulatory Authority (EWURA) Act, 2001

The Act is responsible for regulating energy development and water utilities in Tanzania and requires relevant developers to obtain permits and authorization from EWURA for any proposed development. The proposed development includes issue of energy and water use for the construction and operation of the project.

The developer, UDSM intends to utilize energy from TANESCO using the current national grid connection as well as develop power supply sub-stations. The consultation with EWURA and TANESCO is crucial for this project.

3.3.11 The Wildlife Conservation Act (No.5), 2009

The Wildlife Act, (No.5), 2009, provides for the involvement of the sectors that are entrusted with the custodianship of wildlife resources and habitats in Tanzania. In wildlife conservation activities, the evolution of Environmental Legislation started in 1914 when the Wildlife Conservation Act was enacted. The Game Preservation Ordinance, 1921, established Game Reserves and Game Preservation Ordinance 1940, and made the provisions for national parks thereafter created under the National parks Ordinance, 1948. That legislation was enhanced under the Wildlife Conservation Act No.12 of 1974, which was subsequently amended in 1978 and in the Wildlife Conservation Act No.5 of 2009.
According to section 35 of this Act, an EIA is required for certain developments in Wildlife Management and Protected Areas with the view to provide a sound environmental management and protection practices pertaining to the modalities and substance set out as per the Environmental Management Act, 2004 and International Obligations. This applies to: (a) mining developments; (b) road construction or the laying of pipelines; (c) construction of dams (d) power stations, electrical or telecommunication installations; (e) construction of buildings (permanent and temporary structures).
The following are the pertinent objectives and strategies detailed in the Act:

- To promote conservation of wildlife and its habitat (Protection);
- To regulate development, projects/activities in protected areas (Development);
- To conserve viable populations of species making up Tanzania's fauna and flora with emphasis on endangered, threatened, endemic species and their habitats; and
- Enforcing an EIA process for proposed developments in protected areas and requesting for environmental planning for developments to be carried out in the wildlife areas outside protected areas to minimize negative impacts.

Although the areas surrounding the proposed project area have no major wildlife communities, the minerals processing demonstration center will seek to ensure that the provisions of this Act are observed.

3.3.12 The Forest Act (No.14), 2002

The Forest Act (No. 14), 2002, provides for the management of forests and its main objectives are to promote and enhance the contribution of the forest sector to the sustainable development of Tanzania, and the conservation and management of natural resources for the benefit of the present and future generations. In addition, the legislation aims to ensure ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility.
According to section 18 of this act, an ESIA is required for certain developments in accordance with the modalities and substance as set out in the guidelines by authorities responsible for the protection of the environment. This applies to: (a) commercial logging and forest industry and developments where the area exceeds five hectares, (b) mining developments; (c) road construction or the laying of pipelines; (d) construction of dams, power stations, electrical or telecommunication installations; (e) construction of buildings; (f) agricultural, aqua-cultural or horticultural development on an area exceeding five hectares. Section 70 of the Act forbids any

person from burning any vegetation on any land outside the cartilage of his own house or compound without permission.

Although the project is not in an area of forest reserve, the minerals processing demonstration center will ensure that the provisions of the Forest Act are adhered to.

3.3.13 The Occupational Health and safety Act (No. 4), 2003

The Occupational Health and Safety Act provides provisions for the health, safety and welfare of persons at work in factories or other places of work, provides for the protection of persons other than persons at work against hazards to health and safety arising in connection with work related activities. The occupier needs to notify the Chief Inspector upon closing a registered factory or workplace or a change in the occupier. If the owner intends to alter or add to any factory or building, drawings in blue or white prints must be submitted. Approval may be granted on payment of the prescribed fees. If approval for construction is granted, the Chief Inspector must be called upon for inspections.

Safety Provisions: Part IV of the act provides for conduction of thorough medical examination to employees to be carried out by a qualified occupational health physician on a regular basis. Furthermore an exit medical exam must also be conducted where the employer carries the associated costs. The employer of the workplace must ensure that every dangerous part of machinery is secured. Devices should be installed to promptly cut off power supply to machinery and should have a starting and stopping device installed. The appointed machinery attendant must be sufficiently trained. Also all vessels containing dangerous liquids must be securely covered or fenced off, with a danger warning notice attached. All persons operating on machinery must receive the necessary training. Hoists and lifts must be thoroughly examined every 6 months and issued with a certificate. Every hoist way or lift way must be protected and fitted by gates and must be lifted with an efficient interlocking device to ensure the cage cannot be opened when in motion. Each lift way must be marked with the maximum load it can safely carry. Chains, ropes and lifting tackles shall be inspected every 6 months.

No lifting equipment or cranes may be used unless it has been properly maintained, tested, examined and authorized by the Plant Inspector. All parts of the crane must be examined by the Plant Inspector every 12 months. Every lifting machine should be marked with the maximum load capacity. The Chief Inspector must be notified 30 days before the next inspection is due. The prescribed fee must be paid for the examination to be carried out. The owner of the workplace must ensure safe access to the workplace. It is also imperative to take Precautions where dangerous fumes explosive or flammable dust, gas vapour or substance may be present. Any air receivers shall be marked with the air pressure, fitted with a safety valve and an accurate pressure gauge. The owner must ensure that the factory or workplace is equipped with fire extinguishing equipment, that all flammable materials are kept in a fire resistant store or outside the building in a safe place and that there are adequate escape routes.

Part V provides for Health and Welfare Provision: The employer must ensure that an adequate amount of clean, safe and wholesome drinking water is available. Also all containers or vessels containing harmful substances should not be used for storing drinking water. Sufficient and suitable sanitary conveniences must be provided and maintained and kept clean and well lit. Separate sanitary conveniences should be available for males and females and separate facilities for disabled persons.

Washing facilities should also be made available and kept in an orderly condition. Separate changing rooms for each sex must be provided. It is also compulsory that First Aid facilities are provided and well maintained.

Part VI provides for Safety Special Provision: A risk assessment must be conducted annually where activities involve hazardous processes, equipment or chemical substances. Measures must be taken to protect employees against the inhalation of dust and fumes and must be supplied with the relevant protective equipment as well as for protection of the eyes.

Part VII provides for Hazardous Materials and Processes: Any workplace using electricity shall be inspected and issued a certified once the prescribed fee is paid. Toxic materials and substances shall only be used as a last resort and the number of employees exposed should be kept to a minimum. Washing facilities and protective clothing should be provided in the case where there is a health risk associated with contact of the surface of the body.

Drenching facilities should be available in case of emergency incidents. Workers should be protected from exposure to asphyxiate or irritant gas or vapour. However measures should be enforced to prevent workers from being exposed to ionizing or non-ionizing radiation. Employers shall not cause workers to carry out activities that are not adapted by their physical or cognitive capabilities.

Part VII provides for Chemical Provisions: Measures should be taken to prevent the contamination of the workplace and the environment with hazardous substances. Operations likely to result in contamination of the workplace and environment by hazardous substances shall be isolated from the remainder of the premises. Where circumstances make it necessary for a worker to enter an atmosphere contaminated by a harmful concentration of a hazardous substance, the worker shall be made fully aware of the hazards and be provided with appropriate protective equipment. Also the employer shall ensure proper disposal of all chemical containers residues in such a way that it shall not cause harm to human health and environment. A copy of the chemical safety date sheet for each product shall be forwarded to the Chief Inspector. It has been stated that the employer shall ensure that labeling the packages of a hazardous chemical when delivered is labeled, prior to the handling of chemicals and that copies of chemical safety data sheets are given to the workers.

Part IX provides for Offences, Penalties and Legal Proceedings: Where any person is killed, or suffers serious bodily injury, in consequence of the occupier or owner of a factory or workplace having contravened any provision of this OHSA Act or of any regulation, rule or Order made there under, the occupier or owner of the factory or workplace shall without Prejudice to any other penalty, be liable to a fine of not less than ten Million shillings or to imprisonment. Each incident occurring at the factory or workplace or arising out of or in connection with the activities of persons at a factory or workplace or in connection with the use of a plant or machinery shall, within twenty four hours and in the prescribed manner, be reported to the Chief Inspector. Section 61 of the OHSA stipulates that all practical measures must be taken to protect the employee from the inhalation of dust or fumes or other impurity. Toxic material may only be handled under the correct conditions and the storage of such materials shall be constructed, placed and maintained so as to prevent exposure and impact on the health of employees, as per section 67.

Since the minerals processing demonstration center will involve a number of workers, use of chemicals and hazardous materials, In order to uphold high standards for occupation health and safety for its workers, the project will seek to comply with all relevant provisions of this Act.

3.3.14 The Employment and Labour Relations Act (No.6), 2004

This Act sets out provisions for fundamental rights and protections, which include forced labor, child labor, discrimination, and freedom of association. It also sets out employment standards, wage parameters, working hours, and dispute regulations, among others. Tanzania overhauled its employment and labor laws in 2004 when it enacted the Employment and Labour Relations Act, Act No. 6 of 2004 and the Labour Institutions Act, Act No. 7 of 2004. While the Employment Act provides for labor standards, rights and duties, the Labour Institutions Act constitutes the governmental organs charged with the task of administering the labor laws. Subsequently, in 2007 several pieces of subsidiary legislation were promulgated to facilitate the enforcement of labor rights and standards stipulated in the Employment Act. The new laws further enact employment and labor standards which, by and large, conform to the labor standards set by the International Labour Organization.
The minerals processing demonstration center will ensure that it operates within the requirements of this legislation and will comply with stipulated conditions of the Employment and Labour Relations Act, 2004 so as to fulfil the requirements of their employees.

3.3.15 The Workers Compensation Act (No. 20), 2008

The Act focuses mainly on:

- Provision for adequate and equitable compensation for employees who suffer occupational injuries or contract occupational diseases arising out of, and in the course of their employment, and in the case of death to their dependents.
- Provision for the rehabilitation of employees who have suffered occupational injuries or contacted occupational diseases in order to assist in restoring their health independence and participation in the society.
- Provision for a framework for the effective, prompt and empathetic consideration, settlement and payment of compensation benefits to employees and their dependents.
- Provide for the establishment, control and administration of workers to compensation fund, and the legal framework for the contribution to, and payment from, the fund.
- Give effectiveness to international obligations with respect to compensation.
- Promote prevention of accidents and occupational diseases.

This Act provides the right for compensation to workers for occupational injury in section 19(1). The project will operate within the requirements of this legislation and abide by all relevant sections provided by this Act.

3.3.16 The Prevention and Control of HIV/AIDS Act, 2008

This Act focuses on the prevention, treatment, care, support and control of HIV and AIDS, and to provide for appropriate treatment, care and support using available resources to people who are living with or at risk of HIV and AIDS. Further Section 4(1) provides details to promote public awareness on the cause, mode of transmission, consequences, prevention and controls of HIV and AIDS. Proceeding further it describes the mode of curbing the spreading, prevalence of STIs in the population and adverse impacts resulting from HIV and AIDS, as well as protection rights for orphans.

The increase of care, support and access to persons living with HIV and AIDS is also stipulated in Section 4(1)(f)., Sections 6(1) and (2) describe the necessity for private sectors, in collaboration with government, to implement programs and plans geared towards prevention, care of patients and control of HIV and AIDS in their respective area. Section 6(4) stipulates that TACAIDS is the main coordinator and adviser of such matters.

Section 8(1) describes the necessity of a private company to operate within the requirements of this legislation and be conscious of the public awareness of HIV and AIDS. In addition, Section 9 illustrates how a private company should operate within the requirements of this legislation, to coordinate and establish workplace programs on HIV and AIDS for employees under his control, and such programs should involve the provision of gender responsive HIV and AIDS education, distribution of condoms and support to people living with HIV and AIDS (awareness creation). Finally, Section 19(2) describes the provision of community based HIV and AIDS prevention, support and care services.

Due to development of the proposed minerals processing demonstration center, it will attract different people from different areas e.g. job seekers, business people thus increase the population of the area as the results possibility of increase of HIV/AIDS as such Model mine will operate within the requirements of this legislation in adherence to the requirements of its respective regulations in addition to HIV/AIDS Act.

3.4 GUIDELINES, STANDARDS AND PROCEDURES

3.4.1 World Bank Environmental Health and Safety Guidelines

The World Bank Group's Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of GIIP. The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines such as the EHS guidelines for waste management facilities which provide guidance to users on EHS issues relevant to waste management facilities. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment

3.4.2 The Tanzania Bureau of Standards Act (No.3), 1995

This Act aims at the promotion of specifications of commodities and services, re-establish the Tanzania Bureau of Standards (TBS), the designated national standards authority established under the TBS Act 1975 and repealed by this act. TBS is responsible for developing all kinds of national standards, including environmental standards.

The Standards Act has established National Environmental Standards Compendium (NESC) which is a collection of various standards prepared at different times and recognized by EMA 2004. NESC is divided into three parts. Part 1 comprises of standards that require compulsory compliance. Compulsory standards are categorized as generic or specific. Specific standards cover those industries with peculiar effects to the environment while other industries without a specific standard for Tolerance Limits of Emissions discharge including water quality, discharge of effluent into water, air quality, control of noise and vibration pollution, sub-sonic vibrations, soil quality, control of noxious smells, light pollution, and electromagnetic waves and microwaves

Part 2 of NESC contains those standards that may be implemented on voluntary basis. These include guideline standards, codes of practice, and other such standards that may not necessarily be directly enforced, but whose results are implied in some legal requirements. One of such standards include the Environmental Management Systems (EMS) standards, like TZS 701/ISO 14001 whose compliance specifications include the relevant legal requirements. Part 2 thus has important requirements for companies and developers who wish to demonstrate their commitment to sustainable development by way of self-regulation mechanism. On the other hand, some companies or developers may be compelled to follow these standards because of requirements from mother companies and for other various reasons like certification requirements by environment friendly banks or tenders. Part 2 also includes standards used in evaluating environmental performance.

Part 3 has the requisite test methods that should be followed when testing for compliance. The test methods included are referred to in at least one of the specification standards appearing under Part 1. Although it is not stated in the Act, in the absence of national standards, project proponents are encouraged to use international standards such as those of the World Health Organization (WHO), World Bank, British Standards (BS), European Union (EU), American Public Health Association (APHA), United States Environmental Protection Agency (US EPA) etc. Standards set by the relevant sectors, which also make use of the international standards, are also applicable. Such standards include the environmental standards set under the Mining (Environmental Management and Control) Regulations, 1999. Relevant national environmental standards include:

- TZS 860: 2005 Municipal and Industrial Wastewaters – General Tolerance Limits for Municipal and Industrial Wastewaters: This standard provides permissible limits of important environmental parameters such as BOD, COD, pH, colour, temperature range, total suspended solids and turbidity. It also gives permissible limits of a range of inorganic and organic components. All effluents discharged from the project will need to comply with these specifications;
- TZS 845:2005 Air Quality – Specification: This standard gives permissible emission limits of sulphur oxides, carbon monoxide, hydrocarbons (as total organic carbon), dust, nitrogen oxides and lead. The emissions from mining and earth moving equipment, power generation plant and

other will include SO2, CO, dust and NOX; as such the project will have to observe these limits;

- TZS 983:2007 Air Quality - Vehicular Exhaust Emissions Limits: This standard is mainly derived from EU Directives 96/69/EC, 91/542/EEC and 97/24/EC. This Tanzania Standard gives permissible limits of some common substances found in exhaust emissions of motor vehicles, namely carbon monoxides, suspended particulate matter (PM), oxides of nitrogen, and hydrocarbons. The standard covers all types of vehicles namely, passenger cars, light commercial vehicles, heavy-duty vehicles, and two and four strokes motorcycles and scooters. In order to carry out mining and processing operations, the project will operate a fleet of heavy duty and light vehicles in addition to hiring other vehicular equipment. As such, the project will need to observe the provisions of these standards;
- TZS 932:2006: Acoustics - General Tolerance Limits for Environmental Noise: This standard focuses on urban environmental noise, and does not cover occupation environment. In the absence of other standards it may be used to give indication of permissible noise levels in factory/workshop environment
- TZS 789:2003 - Drinking (potable) water – Specification: This standard prescribes the quality requirements for drinking water other than packaged drinking water. It does not cover the requirements for natural mineral water. It prescribes the quality requirements for drinking water distributed in the food industry, domestic and catering purposes. It applies to bacteriological, biological, virological, physical, chemical and radiological quality criteria. It is intended also to community piped water supplies i.e. those water systems serving cities, municipalities and townships, community standpipes and wells and drinking water distributed by tankers; and
- TZS 931:2006 Protection against ionizing radiation - Limits for occupational exposure: This standard aims at protecting workers, whose practices expose them to ionizing radiation, namely; gamma- and X-rays, alpha, beta and other particles that can induce ionization. The Standard does not apply to non-ionizing radiation such as microwave, ultraviolet, visible light and infrared radiation. It applies to all workplaces in which employees are occupationally exposed or in which there is a potential for occupational exposure to ionizing radiation, unless exempted by the Regulatory Authority

3.5 INTERNATIONAL STANDARDS AND GUIDELINES

3.5.1 World Bank Environmental and Social Framework (ESF)

The World Banks ESSs sets out the requirements for Government of Tanzania (GoT) relating to the identification and assessment of E&S risks and impacts associated with projects supported by the Bank through Investment Project Financing. The standards: (a) support GoT in achieving good international practice relating to E&S sustainability; (b) assist GoT in fulfilling their national and international E&S obligations; (c) enhance non-discrimination, transparency, participation, accountability and governance; and (d) enhance the sustainable development outcomes of projects through ongoing stakeholder engagement.

The following table summarized the Environmental and Social Standards (ESSs) triggered by the proposed mineral processing demonstration center project, that must be adhered to by UDSM.

Table 3-1 Environmental and Social Standards (ESSs) relevant to the project

Environmental and Social Standards	YES	NO
ESS 1: Assessment and Management of Environmental and Social Risks and Impacts	×	
ESS 2: Labor and Working Conditions	×	
ESS 3: Resource Efficiency and Pollution Prevention and Management	×	
ESS 4: Community Health and Safety	×	
ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement		×
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources		×
ESS 7: Indigenous People/Sub-Saharan African Historically Underserved Traditional Local Communities		×
ESS 8: Cultural Heritage		×
ESS 9: Financial Intermediaries		×
ESS 10: Stakeholders Engagement and Information Disclosure	×	

3.5.2 ESS 1: Assessment and Management of Environmental and Social Risks and Impacts

ESS1 requires Borrowers to: identify, evaluate and manage the environment and social risks and impacts of the project; adopt a mitigation hierarchy approach (avoid, minimize, reduce, mitigate, offset); adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities resulting from the project; utilize national environmental and social institutions, systems, laws, regulations and procedures in the assessment, development and implementation of projects, whenever appropriate; and to promote improved environmental and social performance, in ways which recognize and enhance Borrower capacity.

The ESIA study responds to the requirement of ESS1. The ESIA will prepare Environmental and Social Management Plan (ESMP),

3.5.3 ESS2 Labor and Working Conditions

ESS2 requires Borrowers to: promote safety and health at work; protect and promote fair treatment of project workers, with emphasis on vulnerable workers; prevent the use of all forms of forced

labor and child labor; support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law; and provide project workers with accessible means to raise workplace grievances. In order, to ensure fair treatment of workers it will be essential that terms and conditions of employment (hours, rest periods, annual leave, nondiscrimination, equal opportunities and workers organizations) are aligned with the requirements of national law and ESS2. In addition, to protect workers appropriate Occupational Health and Safety (OHS) should be applied to avoid the risk of ill health, accidents and injuries.
The implementation of the project will involve both direct workers, contracted workers and primary supply workers. Workers will be engaged during implementation of the project. Health and safety standard for workers and ensure fair working conditions will be promoted.

3.5.4 ESS3 Resource Efficiency and Pollution Prevention and Management

Project activities under the project components aim at avoiding or minimizing adverse impacts on human health and the environment through eliminating the use of mercury and preventing emissions of uPOPs and other harmful pollutants in ASGM and management of e-waste. The project emphasizes material reuse, recycle and recovery. For all pilot designs, any remaining waste to be treated or disposed of it in a safe manner that includes the appropriate control of emissions and residues resulting from the handling and processing of the waste material. Treatment and disposal process will comply with national legislation and Basel Conventions on storage, transportation and disposal of hazardous wastes.

No trans-boundary waste movements will be anticipated during implementation and operation of the proposed project. In case relevant national legislation will be insufficient, the implementing agencies will adopt Good International Industry Practice (GIIP) alternatives for its environmentally sound and safe management and disposal.

3.5.5 ESS4 Community Health and Safety

ESS4 requires Borrowers addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable
The implementation of the proposed project is not anticipated to have substantial risk to community health and safety. There will likely be no influx of workers and followers into a project area. Implementation of the project will have both direct and indirect benefits to the people's health and safety. Some temporary negative effects are possible due to increased traffic, noise or disturbance to local communities living close to the sites as well as through handling of the e-waste. The capacity building programs in components 1, 2 and 3 will provide necessary knowledge and skills on safety measures to be incorporated in ASGM activities and e-waste recycling sector including safe handling of hazardous waste.

3.5.6 ESS 10 Stakeholders Engagement and Information Disclosure

ESS10 emphasizes stakeholder engagement throughout the project life cycle and requires a Stakeholder Engagement Plan (SEP). It encourages early identification of stakeholders, both project-affected parties and other interested parties. Under ESS10, engagement must be proportionate to the nature, scale, risks and impacts of the project, and appropriate to stakeholders' interests. It specifies process and criteria for information disclosure and meaningful consultation, and requires an accessible and inclusive grievance mechanism, proportionate to risks and impacts *The project has developed Stakeholder Engagement Plan (SEP) to ensure stakeholders are provided with timely, relevant, understandable and accessible information. The developed SEP was adopted and used in stakeholder's consultation during the ESIA study.*

3.6 GAP ANALYSIS BETWEEN THE NATIONAL REGULATIONS AND THE ESF

In Tanzania, subsequent legislations have been enacted which govern/ ensure compliance and considerations for the adverse E&S Impacts and risks associated with the implementation of minerals processing demonstration center project. Relevant laws and regulations shall be employed to govern the construction and operation of the demonstration center under the project. The World Bank requires that all projects comply with national law, but where there is conflict and gaps exist, World Bank policies take precedence, except in cases where national standards are more stringent (e.g. air emissions or effluents).

Notably, there are some differences particularly in the understanding of how E&S issues are handled as analyzed below.

3.6.1 ESS-1: Assessment and Management of Environmental and Social Risks and Impacts:

Principal sector legislation EMA 2004 and subsidiary legislation is not aligned with the new 2021 NEP policy. Many of these are more than ten years old. Some of the gaps identified include the following:

- The ESMF is not a requirement under the Tanzanian E&S management system, it is commonly applied in projects financed by the World Bank. ESMFs are used in projects that contain multiple subprojects whose location, impacts, and risks are not yet known. The ESMF sets out the principles, rules, guidelines, and procedures to be applied to assess and mitigate a subproject's impacts and risks once details are available. Other gaps include the following:
- NEP 2021 enumerates the following capacity-related challenges to E&S management in Tanzania: Inadequate coordination among sectors in environmental management;
  - Low public awareness and knowledge of environmental management;
  - Inadequate land-use planning at several Government levels;
  - Inadequate enforcement and compliance of environmental regulations;
  - Limited capacity in terms of human, financial, infrastructure, technology and tools; and

Recommendations for addressing the gap

In cases where gaps are found between the WB ESF and the Government of Tanzania Environmental requirements, the World Bank Environmental and Social Standards shall take precedence especially on matters which are not explicitly provided in the National Legislation requirements.

3.7 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

Institutional framework denotes those institutions and sectoral boundaries in which the project lies or interacts. These can be determined from political boundaries, acts, regulations and institutional mandates and administrative structures. The proposed minerals processing demonstration center project interests a number of people and administrative units in relation to several policies, laws and plans which were consulted during the ESIA process as stipulated bellow.

3.7.1 National Environment Management Council (NEMC)

Environmental Management Act No. 20 of 2004 re-established NEMC as the responsible authority for the enforcement, compliance, review and monitoring of Environmental Impact Assessments (EIA), including facilitation of public participation processes in environmental decision-making. NEMC undertakes the following activities:

- Performs environmental surveys and advises the government on all relevant matters;
- Enforces pollution control, ensures compliance of the national environmental quality standards and performs the technical arbitration role in the undertaking of EIAs;
- Identifies projects and programs or types of projects and programs for which environmental audit or environmental monitoring must be conducted under this Act;
- Initiates and evolves procedures and safeguards for the prevention of accidents which may cause environmental degradation and remedial measures where accidents occur;
- Conducts research and publishes and disseminates manuals, codes or guidelines relating to environmental management and prevention or abatement of environmental degradation.

3.7.2 Vice President's Office (Division of Environment)

This Division has the overall responsibility of planning and implementation on all environmental matters, including approvals of SEA and EIA certificates. It is responsible for formulation and articulation of policy guidelines necessary for promotion & protection of the environment. It advices the Government on legislative measures related to management of the environment and on international agreements in the field of environment and issues general guidelines to sector Ministries and monitors and assesses activities being carried out by relevant agencies in order to ensure that the environment is not degraded. It also coordinates issues relating to articulation and implementation of environmental management aspects of other sector policies.

3.7.3 Ministry of Minerals (MoM)

The MoM through the Mining Commission (MC) has the following responsibilities: Issuing Licenses (prospecting, mining, Mineral trading) including renewals, Overseeing implementation of the Mineral Policy, Enforcement of laws and regulations for mining and protection of environment in all licensed areas, Environmental monitoring and auditing of the various exploration and mining activities, Mining projects EIS & EMP approvals (through a multi-sectoral

committee under the NEMC), Managing resettlements in Mining areas (through the Ministry of Lands and Housing Settlements) and Mining conflict resolutions.
The Environmental Management Unit (EMU) within the MoM works closely with NEMC to make sure that the social and environmental impacts of mining activities in the country are minimized.

3.7.4 State Mining Corporation (STAMICO)

The main role of STAMICO is the provision of professional mineral services, which include drilling (for mineral and water), land and mine surveying, mineral exploration and investment promotion, promotion and modernization of the small-scale mining sub-sector, promotion of industrial minerals development and mineral consultancy. Its capacity could be strengthened to improve consultation and involvement with stakeholders.

3.7.5 Mineral Resources Institute (MRI)

The Main role of MRI is to offer training up to a diploma level to Mining Technicians involved in the mining industry. It is also involved in research for various mineral processing technologies including alternative technologies to mercury use

3.7.6 Geological Survey of Tanzania

The Geological Survey of Tanzania (GST) serves as a crucial entity in the proposed establishment of a CIP plant by offering comprehensive geological expertise and data. Through detailed surveys and assessments, the GST identifies prospective areas with gold mineralization potential, aids in site selection, and provides essential geological information to investors and stakeholders. Additionally, the GST collaborates with regulatory bodies to ensure compliance with mining regulations, environmental standards, and sustainable practices, thereby facilitating responsible mineral development and informed decision-making within the institutional framework.

3.7.7 Occupational Safety and Health Authority

OSHA was set up in 2001 under the Ministry of Labour, Youth, Employment and Persons with Disability to administer occupational health and safety at workplaces in the country. This Ministry is the main actor with the oversight role of ensuring that decent work is practiced and maintained in Tanzania. It provides directives, technical advice, enforces legislations, proposes amendments, allocates resources, and oversees all activities carried out by.

3.7.8 Government Chemist Laboratory Authority (GCLA)

GCLA is under the Ministry of Health and it is mandated to ensure that all chemicals that are imported and used in the country are regulated. This includes issuance of importation and transport permits. Mercury is one of such chemicals that are regulated.

3.7.9 Local Government Authorities

Under the Local Government Act of 1982 (Urban and District Authorities), Local Government Authorities include the City Councils, Municipal Councils, District Councils, Town Councils, Township, Kitongoji, Ward, Mtaa and Village. The Environmental Management Committee of each jurisdiction:

- Initiates inquiries and investigations regarding any allegation related to the environment and implementation of or violation of provisions of the Environmental Management Act;
- Requests any person to provide information or explanation about any matter related to the environment;
- Resolves conflicts among individual persons, companies, agencies non-governmental organizations, government departments or institutions about their respective functions, duties, mandates, obligations or activities;
- Inspects and examines any premises, street, vehicle, aircraft or any other place or article which it believes, or has reasonable cause to believe, that pollutant or other articles or substances believed to be pollutant are kept or transported;
- Requires any person to remove such pollutants at their own cost without causing harm to health and;
- Initiates proceedings of civil or criminal nature against any person, company, agency, department or institution that fails or refuses to comply with any directive issued by any such Committee.

Under the Environmental Management Act (2004), the City, Municipal, District and Town Councils are headed by Environmental Inspectors who are responsible for environmental matters. The functions of the inspectors are to:

- Ensure enforcement of the Environmental Management Act in their respective areas;
- Advice the Environmental Management Committee on all environmental matters;
- Promote awareness in their areas on the protection of the environment and conservation of natural resources; Collect and manage information on the environment and the utilization of natural resources;
- Prepare periodic reports on the state of the local environment;
- Monitor the preparation, review and approval of EIA’s for local investors;
- Review by-laws on environmental management and on sector specific activities related to the environment;
- Report to the DoE and the Director General of the NEMC on the implementation of the Environmental Management Act; and
- Perform other functions as may be assigned by the local government authority from time to time.

3.7.10 NGOs and Miners Associations

The Governments’ drive to formalize prospecting and Primary Mining Licenses and to stimulate formation of associations of small-scale miners has been effective in giving the small-scale sub sector a stronger voice and further influence over policy, legislation and implementation procedures. The influence of individual societies, associations, faith groups and other organizations is recognized by government and the mining sector and some bodies, like the Lawyers Environmental Action Team and Policy Forum have played key roles in advocating changes to recent draft legislations. Other groups (TAWOMA, AFWIMM, and WIMA) have lobbied for fairer treatment of women miners and processors.

CHAPTER FOUR

4 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

4.1 INTRODUCTION

This chapter provides the baseline environmental and socioeconomic conditions of the project area likely to be affected (positively or adversely) by the establishment of the proposed Alternative Technology Gold Processing and Demonstration Centre (ATEGOPC). This will make a reference frame to mark out the potential environmental and social impacts that might arise during and after implementing the proposed project. The proposed development will have impacts on, or be affected by the social, economic and biophysical environment settings of the project area.

4.1.1 The Msalala District Council

Msalala District Council is one of the three Councils in Kahama District. The council covers an area of 2,635.52 sq.km equivalent to 263,520.2 ha which is equivalent to 5.2% of the total area of Shinyanga region i.e. 50,781 km^2. Approximately, 80% of the total arable land (482,320 ha or 57% of council area) is presently being utilized either for crop production or as grazing land. Farm sizes vary from 0.4 to 20 ha per farm household, averaging to 2.4 – 6.0 ha. The Council has two Divisions of Msalala and Isagehe with 18 Wards; there are 92 villages and 389 hamlets.

The council is situated between latitudes 30°13” and 40°12” south of Equator and longitude 32° 13” and 33° 00” East of Greenwich. The Council borders with Nyan’gwale District Council to the North, Shinyanga District Council to the East, Nzega and Kahama Town Council to the South and Mbogwe District Council to the West.

4.2 THE PHYSICAL ENVIRONMENT

4.2.1 Climatic Conditions of Msalala District Council

Msalala DC is dominated by extensive plains, gently undulating plain and flat plains which cover almost 80% of the area while 13% is valley dominated and 7% is hilly area. Rainfall in the Council starts in late October to early May. The rainy season is characterized by two- weeks to one –month dry spells, being most pronounced in January and February.

4.2.1.1 Temperature

Temperature is relatively constant throughout the year with mean daily temperature ranging from 21 ^{0}C to 26 ^{0}C. Average annual temperature is 21.3 ^{0}C and the hottest month is in July while the coldest weather is in December. The site has a temperate climate with average temperatures ranging from 11°C to 30°C (Bishanga, 2023). However the design and operations of the development centre are not affected by temperature changes.

4.2.1.2 Rainfall

Rainfall in the Council starts in late October to early May. The rainy season is characterized by two- weeks to one –month dry spells, being most pronounced in January and February (COUNCIL, 2022). The average annual rainfall ranges between 750 and 1030mm. Regional wise, the average annual rainfall of about 999mm with average of 6 mm (0.2 in) of rainfall (precipitation) (Bishanga, 2023). The nature of the site has been characterized by hard rock, which does not enhance surface infiltration. The design of the facility has taken care of the surface runoff by constructing storm water drainage system and pond to accumulate the surface water.

4.2.1.3 Topography

Msalala DC is dominated by extensive plains, gently undulating plain and flat plains which cover almost 80% of the area while 13% is valley dominated and 7% is hilly area. Generally the council lies between 345 and 958 meters above sea level where Chella hills are the highest point in the Council. The proposed site is characterized with a gentle slope which facilitate construction of TSF with slope embankment of 1:2 and 1:3 for upstream and downstream edges respectively.

4.2.1.4 Soil Type(s)

The geology of the study area (Gold Processing Plant) comprises sequences of dominantly mafic volcanic rocks and immature sedimentary rocks, which forms the greenstone belt of Tanzania Craton surrounded by granites.

These sequences are subdivided into a Lower and an Upper series on the basis of recognizable upward transition from mafic to felsic lavas, with minor tuffs and interbedded sedimentary rocks. The Lower series consists primarily of basalt, andesite and dacite pillow lavas. The sedimentary rocks include banded iron formation (BIF), recrystallized cherts, and some shale and conglomerate. The specific surveyed area composed of reddish silt and granitic soil, which is a result of weathering of mafic Volcanic and unconsolidated superficial deposits (Bishanga, 2023).

4.2.1.5 Water Resources

Generally the Council and project site particularly is dry with limited water resources. The District and project site generally, there is neither Major river nor Lakes and dams. The nature of drainage system of the district and the Segese ward falls under the areas draining the water to the Lake Tanganyika. Therefore the project site is served by Lake Tanganyika Basin Water Board Office (LTBWB). Underground water is the main water resources for the community living in Msalala district council and the project site in particular.

4.2.2 Administrative Setup

Administratively, Msalala District Council has one constituency represented by one elected Member of Parliament. The 18 elected Councilors each represent one Ward. In addition there are 7 appointed Councilors representing special seats for women. This implies that the Full Council has 27 members. There are 92 villages with politically elected village's chairperson and 389 hamlets chairpersons.

4.3 LOCAL ADMINISTRATION AND GOVERNANCE

Like other areas, the project area is under the village government of Bumva Village, Segese Ward, Msalala District. The village council is made of different committee responsible for different aspects as environment, cleanliness and natural resources, security and conflict resolution, and economy and investment. The chairperson of the village council is the village chairperson and the secretary is the village executive officer (VEO). Msalala DC was established in November, 2012 under The Local Government Act No. 7 of 1982, by which it split from Kahama which is currently a municipal council.

4.4 DEMOGRAPHIC PROFILE, ETHNIC CONFIGURATION AND HUMAN RELATIONS.

4.4.1 Population

Population in the project area has been changing over time, both qualitatively and qualitatively. According to the 2022 National Census the population of Msalala is 378,214 whereas that of Segese is 36,247. At regional level, the population has increased from 1,534,808 in 2012 to 2,241,299 in 2022. Since the last few decades there has been increase of population/ influx of people especially government employees and entrepreneurs who look for business opportunities in the in search for gold mining and related opportunities. This explains the increase of people from nearly 130 thousand people, from 250,727 to 378,214.

Table 4-1 Segese Ward and Msalala DC Population by area, household and sex

Area	**Households**	**Sex**			
		Male	**Female**	**Total**	**HH size**
Segese	7,324	17,992	18,255		4.9
Msalala DC	66,367	187,286	190,928	378,214	5.3
Shinyanga Region	423,373	1,102,879	1,138,420	2,241,299	5.7
URT	14,297,184	30,053,130	31,687,990	61,741,120	4.7

Source: Tanzania Census, 2022

4.4.2 Ethnic groups

The inhabitants around the project area are predominantly the Sukuma and some Safwa. However, people from other ethnic groups are also found in this area, who come as local government administrators, health workers, and seekers of mining opportunities. The envisaged gold processing centre is going to attract more people into this area, the fact which would further challenge and change people’s thoughts and ways of doing things in both positive and negative ways.

4.4.3 Settlement History

Whereas the proper timing of people's settlement in this area is not clearly known, the Sukuma have historically been preoccupied with two main socioeconomic activities—crop farming and livestock keeping. The building of district council headquarters and mining activities in the various villages of Msalala DC and the envisaged processing centre is going to contribute the rapid urbanization which is already happening.

4.4.4 Vulnerability—disabled, women and youth.

Some groups in Msalala DC are vulnerable. These include people with disabilities (PWD), women, the elderly and children. Women are particularly vulnerable to the dominant patriarchal system which bestows decision making powers and control over household resources almost exclusively to a man. Some men are for instance said to sell-off all the produce after harvest and disappear from home only to come back after they squandered all money; others resort to marrying new wives with whom they spend money produced by the man's family. The elderly—especially older women—are vulnerable to traditional beliefs and practices, for which older women with red eyes are accused of witchcraft punishments especially beating—in form of mob justice which may result in death. To respond their financial hardships, some women engage in risky activities especially gold processing which exposes them to mercury. Some children are denied an opportunity to fully appreciate their right to education in order to participate in labour intensive activities like farming and livestock keeping. Some parents for instance are said to direct their children to write wrong answers so that they don't pass their examinations and transition to another level of learning.

Since all the important socioeconomic activities are labour intensive, it is difficult for the disabled people to participate. The centre can sort activities which can be carried out by disabled people. Campaign should be done to stop pushing women to work in polluted and toxic environment.

Moreover, there are existing government-based mechanisms to cover up the vulnerable groups with no-interest loans. Whereas every district councils sets aside 4% of its revenue for women and youth each, for the disabled its 2%. However, the disabled people's access to the necessary social amenities depends on how resourced their families are. Those from poorly resourced households suffer more than those which are less resourced. According to Msalala DC Strategic Plan 2018/2019 to 2022/2023, the district has registered 27 women economic groups and issued loans equivalent to around TZS 70 million, of which 41% have been repaid. For youth, 25 groups have been facilitated with or soft loan equivalent to close to TZS 90 million.

4.5 LITERACY

Interviews with village government administrators indicate that most of the people command the basic literacy skills (reading, writing and counting). Motivation for pursuance of further learning however is not very high since as noted above, some households prioritize livelihood production activities over children's education. The consider children's labour for production of household livelihood resources as more important than going to school.

4.6 OCCUPATION, EMPLOYMENT AND LIVING CONDITIONS

The living conditions of the people in the project area can be categorized into three, namely, good, medium and poor. This categorization is based on the amount resources such as income, quality of residence and volume of business carried out by members of a particular household. That is, those with good living conditions have high quality houses which are spacious, painted walls, cement or claystone floor and roofed with corrugated iron sheets. Most of these are administrators and employees in various government agencies and the relatively successful business people operating retail and whole sale shops, and small-scale mines operators.

Those with medium living conditions are low cadre government employees, medium business people running whole-sale and retail shops. These also have houses of relatively medium quality, with walls made of burnt bricks, roofed with corrugated iron sheets and some with outgoing lifestyles. These have access to adequate food but they face occasional food shortage especially during times of calamities like prolonged droughts, resulting in the withering of immature crops.

The third category is the poor. This category includes those who have limited or no access to land, fishing vessels or are unemployed, the elderly and the disabled. Due to scarcity of land, those who don’t own land can only access arable land for producing by renting it. In the view of local leaders in the project area, this category constitutes the majority of the people. Food and income insecurity among members of this category is quite recurrent because they own or rent small pieces of land which after harvest, they have to sell off the produce in order to meet other needs such as house and land rent and other household requirements. Some of the people also live by selling casual labour. The situation is even worse for vulnerable groups. When such relatives get less, the vulnerable dependents suffer the most. The centre is going to increase opportunities for causal labourers and the need for semi-skilled workers.

4.7 HUMAN RELATIONS AND COEXISTENCE

With regard to human relations, Msalala is a relatively harmonious place with people of different political and religious background—Christians, Muslims and practitioners of traditional religions. There is an informal security arrangement called sungusungu. This is a group of young men led by adults who are in charge of peace and security in Sukumaland. So, incidences like petty theft are managed by this group. Apart from some of the excesses like killing of the older women on witchcraft accusations, this group has been very useful for the maintenance of peace and security. Moreover, at Segese which is a ward[1] centre, there is a police station which among other things is responsible for prevention and control of incidences of armed robbery related to extracted gold.

As noted earlier, the Sukuma are a patriarchal community so decision making power at both household and community level is concentrated on men rather than women. Thus, resources like farm harvest, livestock, means of transport and money are controlled by men on behalf of family members. Change in the position of women is expected as of those who come to look for minerals’ prospects, some are women who also own mining pits and employ labour. The proposed gold processing centre is going to expand opportunities for these differences.

[1] A ward is a conglomeration of a number of villages

4.8 LAND TENURE SYSTEM AND LAND USE

The land tenure system in the project area has three elements by which land can be acquired and or accessed. These include: inheritance, purchasing, and renting. Since the dominant ethnic group is patriarchal land inheritance and related properties like houses goes to male children. Another mechanism of acquiring land is buying it from owners (inheritors). Renting is also another mechanism whereby some people rent out part of their land and cultivate part of it. The centre will make land value appreciate and change the pattern of ownership from being predominantly men to inclusion of women.

4.9 MAIN ECONOMIC ACTIVITIES

4.9.1 Resource centres/towns and cities

There are several resource centres/towns in the proximity of the project. It is located around six kilometres from Segese ward centre. It is also around 30 kilometres from Kahama Municipal Council. It is also located about 250 kilometres from Mwanza city via Shinyanga and Buseresere/Katoro trading centre. Banking services are available at Kahama where banks like NMB, CRDB, NBC and other banks operate. There are commuter buses between Kahama and Geita via the Msalala and Segese (close to the project area).

4.9.2 Medium and large businesses

Whereas the main trading centre is Kahama, Segese is a small centre but has some whole-sale and retail shops. Items mainly sold in these shops are construction materials, and household items like food stuff, utensils, etc. Other businesses include, as noted above, retail and whole sale shops, grains, conventional and mobile banking.

4.9.3 Natural resources (ecology, forests, water)

Ecologically, Msalala seems to be semi-arid, receiving unimodal rainfall. Much of the land is currently dry grassland with scattered trees. Interviews with older people in the area revealed that semi-aridity is a recent phenomenon because in the past the area used to receive heavy rains and was relatively well forested. Several accounts attribute loss of forests to deforestation practices for farming activities. It was noted through discussions and interviews with experts at RUWASA-Kahama that water table in most of the areas at Bumva village. The area is serviced by RUWASA-Kahama and has a deep borehole and an elevated tank which supplies 150 million litres per day. Reliable rainfalls have also enabled agricultural activities, like maize, beans cassava, sweet potatoes are produced.

4.10 ECONOMIC INFRASTRUCTURE

4.10.1 Transport and Communication

The area is served by reliable transport by communiter buses between Kahama and Geita. The East African Raod from Mutukula via Bukoba, Kahama to Singida then either to Arusha through Namanga Border or to Dodoma (Tanzania's Capital City) to Dar es Salaam (Tanzania commercial capital) and main port to other regions of the world passes close to the project area. The same road also goes to Rusumo which is Tanzania's Border with Rwanda and Burundi.

Through the project area are also buses commuter between Geita and Arusha Dodoma and Dar es Salaam and other regions. Around the project area, the main means of public transport is motorcycle (bodaboda), whose fare is between, 1,000 to 3,000, depending on the distance between the two places.

Air transport is At Bulyanhulu Gold Mine, Kahama Municipal Council. Other airports are at Mwanza and Chato, all around 250 kilometres from the project area. Some of the gold processing staff would enjoy air transport services especially between Dar es Salaam and Mwanza where there are regular flights.

Apart from transport infrastructure, the project area is also well served with communication system, especially mobile networks. Nearly all mobile communication networks (Tigo, Vodacom, Airtel, Halotel) are well accessible in the project area. This adequately facilitates communication and eases business. With such elaborate transport and communication system, it is anticipated that the mobilization of materials during construction phase, the operation/ running of the demonstration centre will be eased.

4.10.2 Agricultural activities

Agricultural production is one of the main livelihood activities in the project area. Subsistence is the main type of farming taking place in the project area, where farmers own small plots ranging from 0.25 to 3 acres. The produced crops include rice, maize, sweet potatoes, beans, cowpeas. The district produces up-to 40% of paddy produced in the Lake Zone, Msalala DC, 2018). Rice is produced both for food and sale. Subsistence farmers produce several crops which complement one another, to make a living possible. Thus, in addition to maize and paddy, farmers also produce seasonal crops such as maize, cassava, beans, etc. High yields will make access to food for the project staff cheap.

4.10.3 Livestock keeping

Livestock keeping is also an important socioeconomic activity in the project area. The dominant ethnic group is the Sukuma who are agro-pastoralists. Interviews revealed that the number of livestock (especially cattle) ranges few heads (ten to twenty) in areas around the town-centre to a large number of heads to a large number, i.e. up to 300 heads per household. Apart from cattle, others keep some chicken, goats and even few cows which are pastured on bushy uncultivated areas. Animal products especially meat and milk will be easily accessible to the project staff and customers and indeed, the market of these products will appreciate following population increase in the area. Livestock keeping and agriculture is a source of livelihoods for more than 85% of the people of Msalala, (Msalala DC, 2018).

4.10.4 Large scale and Artisanal/small scale mining activities

since the 1990s, artisanal mining is emerging as a main socio-economic activity. Large scale mining activities take place at Kakola and Bulyanhulu. Moreover, there are several small-scale mining sites (duara) and washing sites (mwalo) in Msalala District. Villages surrounding Bumva village have several mining sites and a series of mining activities. Msalala DC notes that when gold extraction was fully operational, around 80% of Msalala DC's revenues, was from gold. Interviews with officers noted that the district earns TZS 5 billion annually as revenue from mining.

4.11 SOCIAL INFRASTRUCTURE AND SERVICES

4.11.1 Educational services

The project area is well-serviced with education facilities, especially primary and secondary schools. Bumva primary school is located just around 2 kilomteres from the project area. At Segese Centre which is around six kilometers from the project area is a high school called Nyerere Secondary School. According to Msalala DC Strategic Plan (2018-2025), students-classroom ratio in Msalala DC remains high, standing at 94:1 in 2018, having risen from 1:70 from 2014. This is instead of the agreed standard of 45:1.

Relatedly, motivation to have children in school is relatively low because the main socio-economic activities are labour intensive and some parents would want their children to contribute to household labour rather than be in school. Mining activities and the quest for quick money were also said to be getting some children out of school. Part of the centre's training package would be to discourage child labour and the value of education. Msalala is a new district council which probably in the near future will harbor post-secondary colleges like Vocational Education and Training Authority (VETA), and Small Industries Development Organization (SIDO). As of now, such training services can be accessed at Kahama municipal and other centres like Shinyanga (region headquarters) and Mwanza.

4.11.2 Health Issues

The project area is well served with health services provided by health facilities at various levels. Close to the project is a dispensary. District hospital is being constructed close to Segese ward centre. Spread of sexually transmitted diseases is said to be high due to increased interaction between residents and new comers who look for mining and other opportunities. Incidences of prevalence of HIV/AIDS are relatively high, standing at 2.7%[2], due to high interaction of people of unknown status. This is particularly so at major transit points, urban centres and mining areas (Msalala DC, 2018). Relatively high prevalence explains why Msalala DC has made reduction of

[2] The lowest prevalence rate in Tanzania is 0.5%, recorded in Pemba

HIV/AIDS infection its strategic objective number one. The centre will add to this interaction by bring in project staff and inducing people who look for gold processing cervices and related opportunities. For instance, commercial sex is said to be one of the most prevalent activities around mining sites. The centre would need to make sexual and health education and rights (SHER) and awareness raising part of the training package.

Some images of socio-economic receptors in the project area

	
A tricycle transporting building materials in the project area.	Cattle near the Project area
	
A cart pulled by donkey at Bumva	RUWASA operated Water tank at Segese
	
Non-operation gold processing plant close to the project area	Road to the project area

	
Bumva Primary School	Some shops at Segese Centre

Plate 4-1: Sections of existing socioeconomic conditions within and around the Project area

4.12 BASELINE CONDITION OF THE SITE

4.12.1 Fauna

The baseline study on fauna, impact assessment and mitigation measures were done to strictly meet the International Finance Cooperation standards (IFC, 2007) as stipulated under the section Environmental, Health, and Safety Guidelines for Mining specifically on issues related to land use and biodiversity. This was necessary in order to clearly articulate survey aspects pertinent to Protection and conservation of biodiversity, modified habitat, natural habitat, critical habitat, and alien invasive plant species, critically endangered or endangered species, legally protected and internationally recognized areas

As part of the Environmental and Social Impact Assessment (ESIA) of the proposed project, a brief fauna survey was conducted in July 2023 in Bumva village, Msalala District Council in Shinyanga. The project area is about 8 acres, rocky, and open with patchy grassland and a few scattered patches/shrubs (<5% cover). It borders the village, a small mining processing area and a hill.

Presence of Fauna; mammals, reptiles and birds were assessed by visual encounters, using signs such as scats and tracks and the reports of local residents to establish species lists of the Fauna present in the project area. These included walking along pre-established transects (These included walking along pre-established transects (Pollard transect method commonly used in ecological surveys) with binoculars and GPS, taking photos of encountered animals, and recording any animal signs. In addition, time-constrained searches were also conducted. Using this method, an observer spends a fixed amount of time and effort sampling a habitat. It includes not only recording animals seen on a path or moving in front of an observer but also those detected under cover such as logs, barks and rocks (Leon *et al.*, 2002). Species were also opportunistically recorded. Animals were identified using standard field guides. Animals were not sampled by the trapping regime due to the restrictions of time and logistics, although, given the nature of the project area (open, small, species-poor), the methods used in the study were enough to provide information on the fauna present.

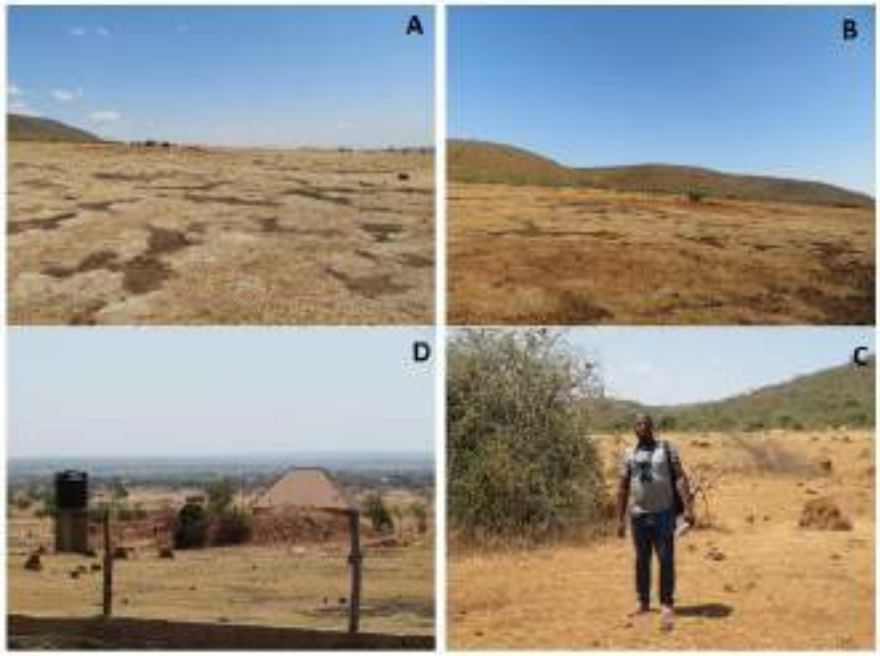


Plate 4-2: Some features of the project site. A: Project site where mineral demonstration plant will be installed. B: Hill adjacent to the site. C: Fauna researcher near one of the few shrubs/patches in the project site. D: A mine processing site next to the site

4.12.1.1 Fauna baseline information

The project inventory baseline study recorded wildlife species, including mammals, birds and insects within the project area (Table 1). Animal signs such as spotted hyenas (*Crocuta Crocuta*) dungs and dung pellets of dik-dik (*Madoqua sp*) were also noted. Droppings of castles and goats were also seen in the proposed project, signalling the area's use by the named domesticated animals. The spotted hyenas, silver-backed jackals (*Canis mesomelas*), vervet monkeys (*Chlorocebus pygerythrus*) and black mamba (*Dendroaspis polylepis*) were reported to be occasionally seen on the site by local people. Other spotted animals include some insects and birds (Figure 4-2). None of these species are endemic to the area/region. Endemic animal species are animals which are native and confined to a particular region and not native to other areas.

Table 4-1: List of Species recorded within the project area and their conservation status (IUCN red list and current population trend).

Species common name	Scientific name	IUCN status	Current population trend
Slender mongoose	*Herpestes sanguinea*	Least concern	Stable
Fork-tailed drongo	*Dicrurus adsimilis*	Least concern	Stable
Grassland pipit	*Anthus cinnamomeus*	Least concern	Stable
Bushveld pupple tip	*Colotis ione*	Least concern	Unkown
Fisher's sparrow lark	*Eremopterix leucopareia*	Least concern	Unkown

Yellow-winged bat	*Lavia frons*	Least concern	Stable
Grasshopper	*Caelifera sp.*	Least concern	Stable

* IUCN (the International Union for Conservation of Nature)
*A least-concern species is a species that has been categorized by the International Union for
(Source: UDSM, 2023)

Conservation of Nature (IUCN) as evaluated as not being a focus of species conservation because the specific species is still plentiful in the wild. They do not qualify as threatened, near threatened, or conservation dependent.

No species of conservation concern was recorded either by visual confirmation or indirectly (animal signs and records from villagers)

Figure 4-1: Some photos of animals and animals' signs taken in the field

(Source: UDSM, 2023)

A: Hyena dung, a sign of the site being used by this species probably for trace passing from adjacent forest hill, B: Dik-dik faecal pellets, C: Bird (Fisher's sparrow lark), D: Cow dung, E: Grasshopper (*Caelifera sp.)*, F: Butterfly (*Colotis ione*)

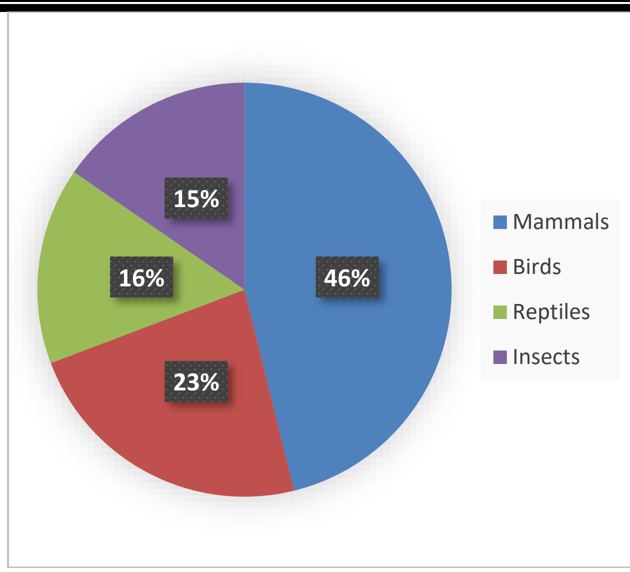


Figure 4-2: Percentage of various taxa recorded in the field

(Source: UDSM, 2023)

4.12.1.2 The animal habitats

At the time of the baseline study in July 2023, habitats included patchy small grassland and a few scattered shrubs/bushes on the rock. There were no mature trees on the site. However, adjacent to the project site, there is a hill with woodland habitat that may be utilized by both domesticated and wildlife. Hence, the nearby area's habitat could provide refuge to animals. The area surrounding the site has no sensitive areas such as critical natural habitats. The area is neither a protected area nor a wildlife corridor/buffer zone/dispersal area. No marine and aquatic habitats at the area.

4.12.1.3 Unique and endangered species

The study has managed to determine that the area has no unique or particularly national-listed threatened or endangered animal species present within or near the project area. All species recorded are widely distributed in many parts of Tanzania.

4.12.2 Flora

The Msalala project site falls under grassland and fallowland dominated by Stoloniferous sward-forming *Cynodon dactylon* and dense mat-forming *Desmodium triflorum*. Broadly, the surrounding land is characteristically regenerating bushed miombo wooded grassland which has been highly disturbed. The remnant of regenerating bushed miombo wooded grassland is more on the South while the rest has been largely disturbed by agricultural activities as evidenced by presence of sunflower, maize, cassava, sorghum, sugarcane and bananas croplands with relics of scattered pockets of indigenous bushes and regenerating miombo species. Within the project footprint, the dominant species in the herbaceous layer was *Microchloa kunthii* while in the woody layer *Brachystegia spiciformis* dominated. The subdominant species were *Chloris pycnothrix* and *Sporobolus stapfianus*. The mean canopy cover of shrubs was about 5% as most were patchy in distribution. The mean height of woody species was about 2.5 meters with large part dominated by shrubs and tree species at shrubby level. The predominance of grasses and shrubby species could be due to the rocky nature of the environment dominated by young/shallow soils but also a result of anthropogenic pressure. Considering the size of the proposed project area which was small and generally homogenous, one plot was established to characterize and quantify the plant species therein. The location of the plot and the physiognomic and floristic vegetation types are summarized in Plate 4-3 and Figure 4-4.

Plate 4-3: [A] Grassland vegetation and fallow land on the project footprint and [B] bushed wooded grassland in the immediate project surroundings.

(Source: UDSM, 2023)

4.12.2.1 Floristic composition and diversity

Species Richness and diversity

The actual plant species richness quantified for the species enumerated in the established plot across vegetation layers in the proposed site was 2 species in shrub layer and 6 in the herbaceous layer. There was no species recorded on site in the tree layer as the site was void of tree species. The low number of plant species recorded on the project footprint can be attributed to biophysical environment and previous anthropogenic disturbances. The latter was evidenced by signs of livestock overgrazing, cultivations/fallow land and cut pole. The predominance by grass layer was due to shallow soils where in large part of the soil cover the rock outcrop was evident.

The observed number of species in the two layers translates to the Shannon-Wiener diversity index of 0.45 in the shrub layer and 1.3 in the herbaceous layer which was comparatively high. Theoretically, the Shannon-Weiner index ranges from 0 - 4.6 where by a value near 0 indicate that every species in the sample is the same and a value near 4.6 indicates that the diversity of species is higher and individuals are evenly distributed between the plots. Furthermore, the Shannon and Wiener diversity indices mostly reported in the tropics range between 1.5 and 3.5 (Kent & Coker, 1992). Thus, the species diversity index of 0.45 and 1.30 recorded for herbs and shrubs in the project area are both regarded to be significantly low species diversity index.

Stocking density of shrub species and herbaceous species cover

The herbaceous species cover within the project area was 87% which indicate that the project site was largely covered by grasses, sedges and phorbs. The total, density for the shrub species was 6 stems equivalent to a density of 150 shrubs ha^{-1}. Such density for the shrub species was quite low and expected given the existing anthropogenic pressure and biophysical environment. The tree species on the project foot print were wanting but recorded in the immediate surrounding vegetation in which they were mostly at shrubby layer.

Despite the observed low species density in the shrub layer, the species which contributed more to the observed density was *Brachystegia spiciformis* which is a common miombo woodland species. As for the herbaceous layer, the cover was dominated by *Microchloa kunthii* (48%) and *Eragrostis patens* (23%) while *Oldenlandia corymbosa* presented the least species cover as it its frequency was low (Figure 4-2).

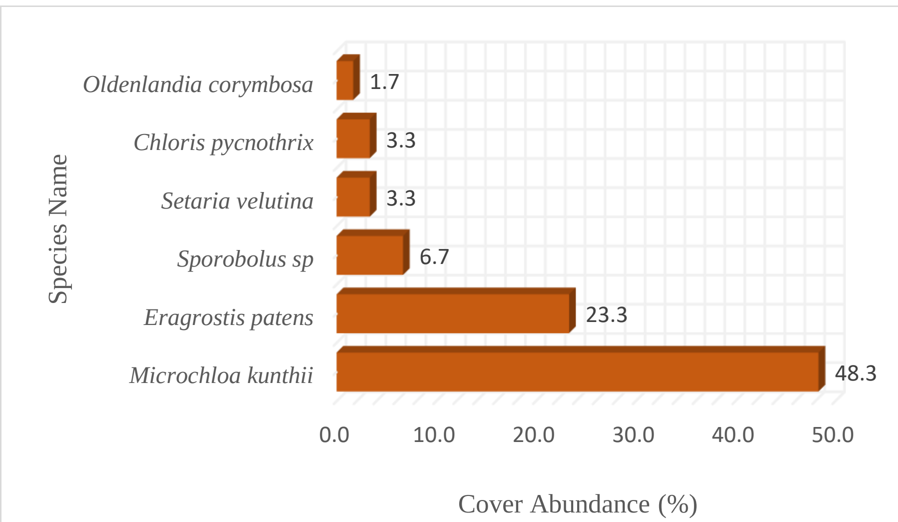


Figure 4-3: Abundance cover for the herbaceous species identified within the project area

(Source: UDSM, 2023)

Figure 4-3 summarizes the results on the overall species richness which encompassed species quantified on the project site and opportunistic sampling in and around the project site. The findings showed that the overall richness was 86 plant species partitioned to 43 shrubs (50%), 19 trees (22%), 12 phorbs (14%) and 10 grasses (12%).

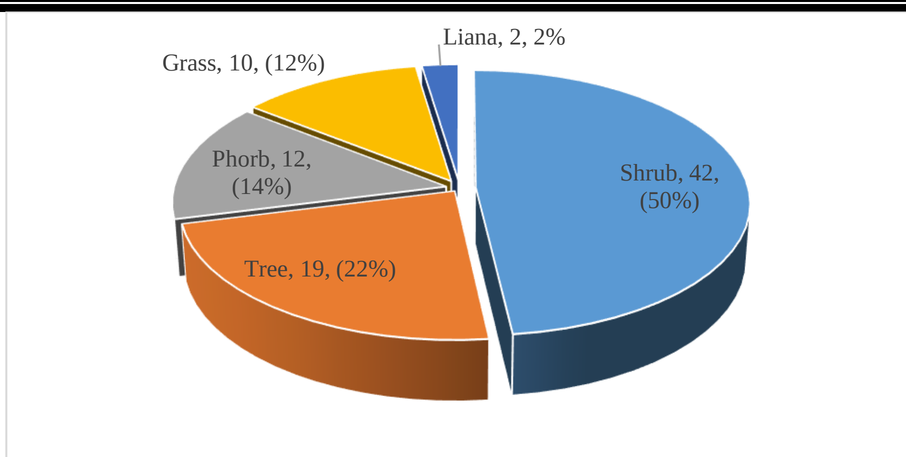


Figure 4-4. Distribution of species by habit

(Source: UDSM, 2023)

The overall number of plant species recorded belongs to a total of 30 families (Figure 4-4). The family which presented the largest number of plant species was Poaceae, the grass family in which 10 species were recorded. This was followed by families Euphorbiaceae which represented 9 species, Rubiaceae and Papilionaceae which presented 8 species each. The remaining plant families were represented by 4 species (4 families), 3 species (3 families), 2 species (8 families) while 12 families were under represented having 1 species each. This further indicate that the vegetation around the project site was diverse. The distribution of the recorded families per habit revealed the largest number of families in the shrub layer followed by trees in which 13 families were recorded. In the herbaceous layer, which was further partitioned to phorbs, climbers and grasses, a total of 8, 2 and 1 families were recorded respectively. As observed in the overall results, families which presented the largest number of species indicated in brackets were Poaceae (10), Papilionaceae (5), Euphorbiaceae (5) and Rubiaceae (5). The other families in all layers showed between 3 and 1 species with majority of families being on the lower arm.

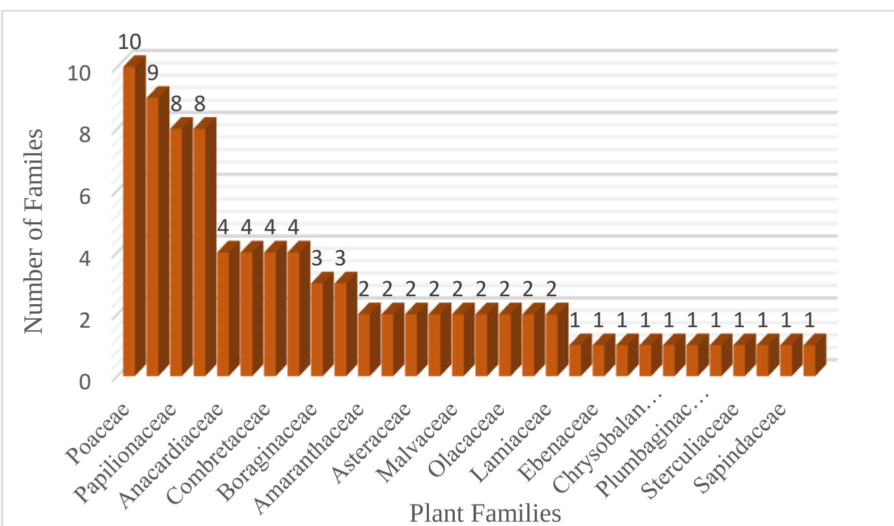


Figure 4-5: The plant families recorded within and around the project site and their corresponding number of species

(Source: UDSM, 2023)

4.12.3 Water Supply and Treatment services

Water supply service at the District is mainly provided by RUWASA. The District is getting water from a number of sources as outlined below;

- Borehole
- Shallow well
- Springs
- Charcoal dams
- Pipeline from Lake Victoria

The main water sources used in the project site located at the Bumva Village, Segese Ward in Msalala District council are the shallow wells and springs. The Figure 4-6 shows shallow well in the proximity of the project site.

Figure 4-6: Example of the shallow well proximity to the Project site at Bumva village, Segese ward

(Source: UDSM, 2023)

Shallow wells water sources are characterized of high turbidity because they are not well protected from runoff and also other pollution from the human operations. Drilling of boreholes and Rainwater harvesting alternatives are the possible and feasible intervention to be part and parcel of this proposed project in Biatika village (project site). Water samples were taken at the community water taps at Segese village and the results as shown in Table 4-2 below.

Table 4-2: Water Quality status at the community shallow well

Parameter	**Sampling Points/Locations**		**Standard TZS 860:2019**	**Method**
	Sample Community 1	Segese Sample Community 2		
Mercury (mg/l)	<0.0010	<0.0010	0.001	Metalyser HM3000 (Stripping Voltammetry technique)
Arsenic (mg/l)	<0.0010	0.0010	0.01	
Copper (mg/l)	<0.01296	<0.0010	0.5	
KEY				
	Fail		Pass	

(Source: UDSM, 2023)

There is a lot of small mining operations in proximity to the project site and the ward in general. Nature of operation of the small miners in not safe for the environment and therefore relying on the water from shallow wells poses high health risks and safety to the consumers. The Gold processing activities also need water with good quality (drinkable water) during gold processing and therefore the issue of having reliable and safe water is of paramount important.

Water supplied at the council covers only 46% of the District council population. RUWASA face a number of challenges to reach the intended water supply demand as outlines below;

- Limitation of Budget to construct water supply infrastructure
- Dry out to some water sources during the dry season especially shallow wells
- Some areas with aquifers of low water discharge

The proposed project should consider design of an alternative water supply sources for its sustainable operations. Water quality issues is also of great concern, there is no complete water treatment systems on the water supply schemes at the area. Shallow wells are characterized by high turbidity because they are not well protected from runoff and also other pollution from human operations. Drilling of boreholes and Rainwater harvesting alternatives are the possible and feasible intervention to be part and parcel of this proposed project in Bumva village, Segese Ward.

4.12.4 **Stormwater Management**

The project site does not have a storm-water management facility. The possibility of storm-water generation is high and therefore the management aspect for storm-water should be considered. The constructions of the storm-water drainage channels and storm-water management ponds/ rainwater harvesting ponds are examples of storm-water management interventions. Table 4-3 below shows the estimates of the quantity of the storm-water generation per year at the proposed project site.

Table 4-3: Types, amounts and management of storm water during the operation phase

Waste	**Types**	**Amount**	**Treatment/ Disposal**
Storm water	Runoff	Based on an average of 20% paved project area and 80% unpaved project area; the estimated runoff (m^3/year)= K×I×A Where by	To be directed to storm-water drainage system present to be constructed

		K = Runoff coefficient (0.85 for paved surface and 0.7 for unpaved surface) I = Rainfall Intensity (1100mm) A = Area of the catchment (m^2) = (0.85*0.2*1.1*32,375)+(0.7*0.8*1.1*32,375) Strom-water generation per year for 8acres of the project site =26,000m^3/year	Rainwater harvesting Pond/Dam

(Source: UDSM, 2023)

4.12.5 Baseline Noise Levels

The noted sources of noise at the site during measurement were considered to include wind, birds and insects. As shown in Table 4.4, the hourly equivalent sound level recorded at all assessed locations were within local standard (i.e. (TBS, 2001): EMDC 6(1733), Limits for Environmental Noise). Noise level was in the ranged from 38 to 60 dB (A).

Table 4-4: Measured baseline noise level at the proposed site

Category	Measuring Location	Session			Source of Noise
		Daytime			
		Min, dB(A)	LAeq, (1h)	Max, dB(A)	
Site	A point within the proposed site	38	40	60	Wind, birds and insects
Noise Limits	(TBS, 2001): EMDC 6(1733), Limits for Environmental Noise. Residential and Industry/small scale production and commerce	**DAY = 60** **NIGHT = 50**			

Source: (NEMC lab result report, 2023)

4.12.6 Existing futures on the proposed site

Currently there is no any infrastructure that has been developed within the site thus, the whole site area is covered by shrubs and few trees

4.12.7 Utility and services

There are no major utility services too or close to the proposed project site. This is mainly because the site is located a bit far from residential areas.

4.12.8 Distance to the residential houses

The distance from the project area to the residential houses is approximately 3 -4 kilometers.

CHAPTER FIVE

5 STAKEHOLDER CONSULTATIONS AND PUBLIC INVOLVEMENT

Section 89 of the Environmental Management Act (EMA, 2004) provides directives on public participation in the EIA. Regulation 17 of the EIA Regulations (URT, 2005) provides further details and procedures for public participation in the EIA process. For this project, stakeholder's involvement is considered very crucial, and is given special attention. It is also understood that the project could be seeking financial support from international lending institutions and therefore be subject to international requirements. International Finance Corporation (IFC) policies, standards and guidelines are generally considered to represent international best practice in this arena, including those on project consultation and disclosure. The IFC 'Good Practice Handbook' on Stakeholder Engagement[3] is the most commonly used reference point for best practice.

Recent reviews of engagement and consultation, not only in the mining industry and land rights, have resulted in the increased recognition of the importance of Free Prior and Informed Consent (FPIC) (see Box 1 below).

Box 1: Free, Prior and Informed Consent

For projects with significant potential adverse impacts to the affected communities, the client's consultation process will include their free, prior and informed consultation and informed participation. Such consultation should be "free" (free of intimidation or coercion), "prior" (timely disclosure of information) and "informed" (relevant, understandable and accessible information), and should continue through the entire life of the project and not only during the early stages of the project.
IFC Performance Standard 1, Guidance Notes

5.1 METHODOLOGY AND DATA COLLECTION

5.1.1. Stakeholder Engagement Plan

The team identified the main stakeholders, and prepared a plan for Consultations as presented in Table 8-1. The Consultation Plan mapped out the stakeholder engagement process in each phase of the ESIA study. The Plan is adaptive and subject to change based on stakeholder responses/requirements. The overall consultation process has been designed to comply with the requirements for public consultation as prescribed in Tanzania's EIA and Audit Procedures for stakeholder engagement as well as the IFC 'Good Practice Handbook' on Stakeholder

[3] 'Stakeholder Engagement: A Good Practice Handbook for Companies doing Business in Emerging Markets', IFC, 2007; http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_StakeholderEngagement_Full/$FILE/IFC_StakeholderEngagement.pdf

Engagement. Stakeholder engagement activities were carried out from 24th to 27th July, 2023. This was based on a Stakeholders Engagement Plan (SEP) developed for the ESIA process. The engagement ensured that all stakeholders were given an opportunity to participate in the scoping exercise.

Table 5-1: Stakeholders consulted during the Scoping Exercise

S/N	Stakeholder	Position(s)	Interest/influence	Mode of engagement	Venue
1.	District Commissioner's Office	-District Commissioner -District Administrative Secretary	In charge of peace and security for mining activities in Kahama District -Chairs district peace and security committee	Key Informant Interview (KII)	DC's Office-Kahama
2.	Regional Mines Office (RMO)	-Ag. RMO -Principal Mines Technician	Regulates mining activities in Shinyanga Region, i.e. - issuance of mining permits -news or terminates miners' permits	KII	RMO's Office-Kahama
3.	Lake Tanganyika Basin Water Board	-Head of Office -Water Resources Engineer	-Ensures quality and integrity of streams/rivers draining to Lake Tanganyika -Issues water use permits and oversees observance of water use regulations	KII	LTBWB-Kahama
4.	Msalala District Council	-Ag. District Executive Director (DED) -Community Officer -District Environmental Management Officer (DEMO) -Forest Officer	-Manages the Msalala district socioeconomic development including gold extraction, processing and marketing. -Collects development levies from mineral processors. -Oversees environmental integrity, economic activities, agricultural production, trading activities, etc.	KII	DED's Office-Msalala
5.	RUWASA-Kahama District	-Ag. District Manager	-Incharge of water supply in the project area -Collects water user charges	KII	RUWASA-Office-Kahama
6.	OSHA – Lake Zone	-Inspector	-Monitor OSHA requirements Compliance -Issues of compliance certificates	KII	OSHA Lake Zone Offices
7.	Government Chemist Laboratory Authority (GCLA)	-Inspectors -Chemist	-Provision of Labaoratory analysis of chemicals	KII	GCLA Office - Mwanza
8.	Fire & Recsue Force - Kahama	-CPL. (Inspector)	-Issues fire safety training -Issues fire safety compliance certificate.	KII	Fire & Rescue Force Offices - Kahama

S/N	Stakeholder	Position(s)	Interest/influence	Mode of engagement	Venue
9.	Segese Ward Development Council (WDC)	-Ward Executive Officer -members of WDC	-Coordinates socioeconomic development efforts, including mineral processing and environmental protection.	Consultative workshop	CCM Premises-Segese
10.	Bumva Village Community Assembly	-Ward Councilor -Village Chairperson -community members	-Host the project -Positive and negative impacts of the project will be first felt by Bumva villagers who live in proximity to the project. -Traverse in proximity to the project area to the neighbouring villages	Village Assembly	Bumva Primary School Grounds

5.1.2 Stakeholders Identification and Consultations

Stakeholders refer to people, groups, or institutions which are likely to be affected either negatively or positively by a proposed intervention. Stakeholders also includes those who can affect the outcome of the intervention as well as those who may have interest in a project, i.e. those who have the ability to influence the project outcome either positively or negatively. They range from international, to national, local government authorities, to local affected communities or individuals, and groups with special interests in the project. The identification of stakeholders was based on the following criteria;

- Level of impact the project has on stakeholders
- Stakeholders roles' and responsibilities
- Stakeholders' interest and Influence on the project implementation

On the basis of the above criteria, the following groups of stakeholders were identified:

a) Stakeholders who will be directly and positively or negatively affected;

Stakeholder groups who are considered to be directly affected by the project (project-affected groups), i.e. Bumva village community in Segese ward.

b) Stakeholders whose cooperation, expertise, or influence would be helpful to the success of the project

These are government officials including agencies, local government authorities (Regional and District) up to the lower level (ward and village) and private companies that are likely to be involved in implementation or regulation concerns by the project because of their knowledge and experience they provide valuable inputs to the proposed project. These include different expertise in charge of environment, agriculture and livestock keeping. The local government authorities (i.e. district government), ward leaders through WDC, village government and community were consulted during the scoping phase through District management team were conducted.

Ultimately, 7 groups of stakeholders (as in the table above) of which a total of 129 individual stakeholders were covered.

5.2. STAKEHOLDER INVOLVEMENT

The team consulted various stakeholders/bodies within the project area (Table 8-1), including District Commissioner's Office Kahama District, Experts at Msalala District Executive Director's office, Segese Ward Development Council, and Bumva Village Community Assembly. Other stakeholders included Regional Mines Office (RMO), RUWASA Kahama DC, and Lake Tanganyika Basin Authority at Kahama. It is expected that the leaders will disseminate the project information to the community through their regular meetings.

Table 5-2: Stakeholders consulted during the Scoping Exercise

S/N	Stakeholder	Position(s)	No. of participants
1.	District Commissioner's Office	-District Commissioner -District Administrative Secretary	2
2.	Regional Mines Office (RMO)	-Ag. RMO -Principal Mines Technician	2
3.	Lake Tanganyika Basin Water Board	-Head of Office -Water Resources Engineer	2
4.	Msalala District Council	-Ag. District Executive Director -Community Officer -District Environmental Management Officer (DEMO) -Forest Officer	4
5.	OSHA – Lake Zone	-Inspector	2
6.	Government Chemist Laboratory Authority (GCLA)	-Inspectors -Chemists	3
7.	Fire & Recsue Force - Kahama	-CPL. (Inspector)	4
8.	RUWASA-Kahama District	-Ag. District Manager	1
9.	Segese Ward Development Council (WDC)	-Ward Executive Officer -members of WDC	37
10.	Bumva Village Community Assembly	-Ward Councilor -Village Chairperson -community members	81
Total			138

5.2 ISSUES RAISED

The main concerns, expectations and issues raised during various meetings and discussions with individuals and groups of stakeholders are summarized below and detailed meetings notes are found in Appendix I whereas particulars and signatures of consulted stakeholders is provided in Appendix II Stakeholders' expectation is that the developer will take their views into consideration in the planning and implementation of the project. At the time of this stakeholder engagement exercise, the project area was already identified and the process of transfer to right of occupancy to the project developer was ongoing. The area used to be village land and upon request village leaders and community members cordially consented to provide the land for the project and signed minutes and attendance forms attached and shared with DED's office and the developer, the University of Dar es Salaam.

5.3 KEY CONCERNS, EXPECTATIONS AND ISSUES RAISED BY STAKEHOLDERS

i. Excitement about commencement of the project

Stakeholders at all levels were eagerly waiting for the project to take-off because they think the project would make significant contribution to the development of District. Stakeholders exposed very welcome remarks because land acquisition issue is ongoing smoothly and stakeholders from district to community level have interest in the project especially because it will raise incomes and government levies.

ii. Control of contamination resulting from use of mercury

Stakeholders at both district and community level pointed out that the district's land office was surveying land which adjacent to the project area in order to ensure parallel development of the centre and that of areas around it.

iii. Health risks

Concerns were raised about commercial sex at mining areas which has resulted in relatively high prevalence of HIV/AIDS in the area. Drawing from practices around the existing mining sites, some people were said to hide their status and engage in unsafe sex with people whose health status is also unknown. On the other hand, it also noted that the project will improve human health in the project area and beyond because of reduced use of mercury in gold processing often without any protective gears.

iv. **Developer's contribution the community's development efforts**

There was concern at both district and community level about whether the developer would contribute to new or ongoing development projects like water supply, electricity, health facility construction, road paving etc. at Bumva Village and Segese Ward.

v. Increase of people in and around the project area upon the opening of the centre.

A comment was raised by stakeholders that the centre would attract young people from various areas with different socio-cultural backgrounds, which would in turn introduce new patterns of behavior in the area, some of which may not be acceptable.

vi. Expected benefits to the local community-employment opportunity, increased gold processing efficiency

Stakeholders appreciate the project intention to set-up the centre at as it would increase productivity in gold processing and therefore people's income, improve people's and environmental health. Improvement of human and environmental health will be because of reduced use of mercury in gold processing.

5.4 ADDRESSING STAKEHOLDER'S ISSUES AND CONCERNS

Issues which were raised, some were addressed by the ESIA team while others were noted to be clarified by the developer, and some others were not. Appendix I presents a matrix summarises all the issues raised by stakeholders and responses given by ESIA team.

5.5 ACCEPTANCE OF PROPOSED PROJECT

Stakeholders were involved and participated in the ESIA process through key informant interviews, discussions and community engagement meetings. Through these mechanisms, stakeholders were given opportunity to point out issues, concerns and views on the project and their acceptance of the project. An issue raised by one individual or a group of people was cross-checked by discussing it over with other groups. Generally, and as appendix I & II illustrates, there was a clear consensus among various stakeholders on their high acceptance of the project. Table 5-3 below is illustrative of this.

Table 5-3: Level of stakeholders' acceptance of the project

S/N	Stakeholder	Influence			Interest			Level of Acceptance		
		H	**M**	**L**	**H**	**M**	**L**	**H**	**M**	**L**
1.	National Environmental Management Council (NEMC)/ University of Dar es Salaam-Developer									
2.	Kahama District Commissioner's Office									
3.	District Management Committee									
4.	Regional Mines Office (RMO)									
5.	Occupational Safety and Health Authority (OSHA) – Lake Zone									
6.	Government Chemist Laboratory Authority (GCLA)									
7.	Fire & Recsue Force - Kahama									
8.	Lake Tanganyika Basin Water Board (LTBWB)									
9.	RUWASA- Kahama DC									
10.	Segese Ward Development Council									
11.	Bumva Village Assembly									

Key: Levels
H= High
M= Medium
L= Low


Meeting with Kahama District Commissioner


Meeting at Regional Mines Office, Kahama


Meeting with Head of Office, Lake Tanganyika Basin Water Board, Kahama


Meeting with WEO, Segese Ward


Meeting with ward leaders at Segese.


Meeting with women at Bumva

Village Meeting at Bumva Secondary School

Village Meeting at Bumva Secondary School

Source of water: Shallow bore hole at Bumva

Plate 5-1: Images of stakeholder engagemenet activities

5.6 SUMMARY OF THE SYNTHESIS

Following stakeholders consultation and site visits a synthesis was done, and the following issues were identified:

i. The proposed site is rightfully owned
ii. There is a shallow well in the proximity of the site.
iii. The project site is also not in close proximitiy to any major river, lake or dam.
iv. The site is not connected to services such electricity. However, these are available about 1 km from the site.
v. There are no endemic species in the area/region.
vi. The Local Government at Bumva village, Segese ward, Msalala District, Shinyanga are optimistic that the project will bring out social economic benefits to community and the country in general.
vii. The scoping exercise was able to identify suitable sampling locations for social and environmental samples.

CHAPTER SIX

6 ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROPOSED PROJECT

6.2 INTRODUCTION

The purpose of this section is to identify and, where appropriate, quantify the primary biophysical and socio-economic effects expected to result from construction operation of the proposed demonstration centre. The Study area impacts were assessed in two impact zones;

1) The direct impact zone, the area that is comprised of the area immediately bordering the project area, outside the proposed project area i.e. Bumva area.
2) The zone of influence, which includes the wider geographical areas within proposed project (i.e. Segese Ward, Msalala District, Shinyanga Region and Country level).

The development of proposed project might lead to some environmental and social impacts on a number of receptors. The impacts are often spread over the entire project area. The impacts may be direct or indirect, positive or negative, short-term or long-term and irreversible. The described impacts are associated with the implementation of several project components in particular environmental settings. In assessing identified potential Project' impacts, consideration and attention will be paid in the establishing the cumulative nature of each impact. The identified key components will be employed by undertaking a number of activities. Execution of these activities at a particular location where a specific component or its sub-components are implemented will result to positive or negative impacts on the environment. Hence, the identified potential impacts of the implementation of the proposed project considered these activities on the described environment.

6.3 METHODOLOGY FOR IMPACT IDENTIFICATION

The environmental and social impact assessment was carried out at different levels to reach accurate results about the project impacts and the suitable mitigation measures to minimize negative impacts and maximize positive impacts resulting from the Gold processing centre. Cumulative effects were also addressed taking into account other projects or actions planned in the study area. Each potential positive and negative impact resulting directly or indirectly from the project was categorized based on **Magnitude and Sensitivity of the receptor**.

Magnitude of Impact: The impact resulting from the project was categorized as a positive or negative impact; the latter was further analyzed and its magnitude assessed as: Low, Moderate, Substantial or High. Various considerations come into play as the consultant and experts assessed the impacts, the main parameters are:

- **Duration** - As the time duration of the impact increases, it is weighed more heavily. Special consideration is given to impacts that go beyond the project's anticipated life-expectancy.
- **Time** – The time of which an impact commences or occurs can be vital to construction and maintenance operations.
- **Spatial** – The area impacted is to be considered, as some impacts may extend beyond the project's boundaries or interfere with land regulations, etc.
- **Probability** – The chance of an impact occurring and its frequency is to be assessed

- **Reversibility -** The possibility and extent to which an impact can be intervened or mitigated for a factor to return to the Baseline environment
- **Compliance** – National and international standards and regulations may dictate an impact's maximum allowable consequence.

The analysis and assessment of the identified impacts utilized the baseline information and collected data so as to establish significance of each impact.

The approach to impact prediction is to give ratings (quantification) for each identified potential impact and produce a matrix of impacts against Project activities that will be undertaken during construction, operation and decommissioning phases of the Project. Determination of the "significance" of a particular impact is a key aspect in the analysis and classification of these impacts. In order to determine the significance of an impact, various approaches including professional judgment, quantitative mathematical models, experiments and physical models and case studies may be used.

Since the proposed site of the demonstration plant is located in an area which has other activities, it is likely that some of the potential impacts of the development will have cumulative effects. A number of criteria in combination were considered in assessing the impact's significance. The chosen criteria include the impact's magnitude, scale, duration, exposure and probability of occurrence of that impact. These criteria were assigned scores, which will then be combined in order to determine the impact's "consequence and likelihood".

The impact score magnitude is determined as "high", "substantial", "moderate", or "low", (Table 6-1). Whereas the score allocates from 4 for "high" to 1 for "low". The unknown category score is assigned 4 as it contains the risk factor of having a highly significant impact but with no data or information to ascertain its significance.

The scoring for the scale of the impact intends to establish the indication of the geographical extent of the impact. As such, the scoring is determined on whether the scale is "national", "regional", "district", "local", and "site specific or unknown''. The scoring is again assigned 5 to 1 respectively and 5 if "unknown". On the other hand, the scoring for the impact duration seeks to establish an indication of the duration or time over which the impact will be experienced. it is scored on a scale of 5 to 1, whether the duration is "permanent", long-term", "medium-term", short-term" or "transient (very short duration)". If the duration is "unknown" it is scored 5. The exposure of the impact seeks to establish an indication of the frequency of the activity that may cause the impact, or the continuity of the exposure. It is also scored 4 to 1 if it is " high", "substantial", "moderate", or "low". If it is "unknown", the score is allocated to 4. It should be noted that in assessing the exposure the impact is also assessed on whether it is a discrete event or a prolonged exposure from a single activity or event.

The probability of the occurrence of the impact seeks to assess the degree of certainty associated with a potential impact. The assessment was carried out by establishing whether the occurrence of the impact is "highly likely", "likely", "possible", or "unlikely". The scoring was based on a scale of 4 to 1 respectively with the "unknown" category also scored 4.

In carrying out these assessments, data and various information was used to establish a level of public concern and own expert judgment. The significance of each impact was assessed through a scoring system that looks at the impact's "magnitude", "scale" and "duration". Also, the assessment of the significance of the impact in terms of "exposure" and "probability" of occurrence is carried out through a scoring system as outlined in the following table:

Table 6-1: Significance of Impact Assessment

Criteria	Description	Possible Results			
		Term	**Description**		**Score**
Impact Magnitude	An indication of the **severity of the impact**, either positive or negative	**High**	Where natural, cultural or social functions or processes permanently		**4**
		Substantial	Natural, Cultural or Social functions are altered to the extent that they temporarily cease		**3**
		Moderate	The affected environment is altered but natural, cultural or social functions continue, albeit in a modified way		**2**
		Low	The environmental is impacted in a way where the natural, cultural and social functions and processes are not affected		**1**
		Unknown	Magnitude of impact is Unknown		**4**
Scale of the Impact	An indication of geographical extent of the impact	**National**	Affects the resources of the country		**5**
		Regional	Affects the resources of the region		**4**
		District	Affects the resources of the district		**3**
		Local	Affects the project area and surrounding villages		**2**
		Site-specific	Localized, confined within the liscence/ project area		**1**
		Unknown	The Extent of the impact is unknown		**5**
Duration of the Impact	An indication of the duration or time over which the impact will be experienced	**Permanent**	The Impact will remain permanently		**5**
		Long term	The impact will extend into post closure face but not permanently		**4**
		Medium term	During the operational life of the Project		**3**
		Short term	Shorter than the operational life of the project		**2**
		Transient	Very Short Duration		**1**
		Unknown	Duration of the Impact is Unknown		**5**
Exposure to Impact	Indication of **frequency** of the activity that may cause the impact, or the continuity of exposure	**Term**	**Discrete Events**	**Prolonged Exposure from single activity**	**Score**
		High	Daily or Continuous	Exposure in perpetuity	4
		Substantial	Weekly/once per week	Continuous exposure into closure or post closure	3
		Moderate	Monthly/once per month	Continuous exposure during construction and operations Phases	2

		Low	Bi-annually/ Anually	Continuous exposure throughout one phase or Prolonged exposure yet finished before end of a phase	1
		Unknown	Frequency not known	Continuity not known	4
Probability of the occurence	Assessment of the **degree of certainty** associated with a potential impact	Highly likely	Very likely or certain to occur		4
		Likely	Likely to occur		3
		Possible	May possibly occur		2
		Unlikely	Unlikely to occur		1
		Unknown	Probability of the occurrence unknown		**4**

Table 6-2: Significance of Impact Assessment

Consequence	**Magnitude + Scale + Duration**	**1-4**	**5-7**	**8-11**	**12-14**
		Low	Moderate	Substantial	High
Likelihood	**Exposure + Probability**	**1-2**	**3-4**	**5-6**	**7-8**
		Low	Moderate	Substantial	High

The consequence of the impact was determined by adding the scores for "magnitude", "scale" and "duration" of a particular impact (Table 6-2). The addition of the scores for "exposure" and "probability" of occurrence of an impact will be used to determine the impact's likelihood of occurrence. The description for the "Consequence" and "Likelihood" of the impact are then expressed, based on the obtained score, as either "low", "moderate", "substantial", "high". In order to determine the overall significance of the impacts, a matrix of the scores of the "Consequence" and "Likelihood" is then used as shown in Table 6-3 using the color codes.

Table 6-3: Significance of Impact Matrix

Impact Significance					
		Low	Moderate	Substantial	High
Likelihood of the impact (Exposure x Probability	**Low**	L	M	M	S
	Moderate	L	M	S	H
	Substantial	M	S	S	H
	High	M	S	H	H

Table 6-4: Environmental Screening Matrix

Phase and Activities	Physical and Water Resources					Soil	Ecology	Socioeconomic			
	Air Quality	Noise level	Traffic Congestion	Drainage	Solid Waste	Soil Quality	Terrestrial Vegetation	Employment Opportunity	Traffic Mobility	Temporary loss of small scale business	Accident risks
Pre-Construction Phase											
Survey activities	-	-	-	-	-	-	-	✓	-	-	-
Land acquisition and requisition	-	-	-	-	-	-	-	✓	-	-	-
Design	-	-	-	-	-	-	-	✓	-	-	-
Mobilization Phase											
Transportation of construction equipment	✓	✓	✓	-	-	-	-	✓	-	-	✓
Campsite preparation	✓	✓	-	-	✓	✓	✓	✓	-	-	-
Construction phase											
Movement of vehicles and equipment	✓	✓	✓	-	-	-	✓	✓	✓	✓	✓
Vegetation clearance	-	-	-	-	-	-	✓	✓	-	-	-
Operation phase											
Regulating and Metering Station operation	✓	✓	-	-	-	-	-	-	-	-	✓

These are presented in the following subsections.

6.4 THE PRE-CONSTRUCTION PHASE

Positive Impacts

6.4.1 Employment opportunity

The planning of the project implementation will involve people of different expertise, including architects, engineers, environmental experts, procurement experts and so forth. The experts will gain economic benefits as they implement various tasks for the project.

Consequence	**Positive & short term**

6.4.2 Economic gains to local community

Feasibility and design teams are likely to contribute to economic gains in communities around the project area through local content procurement of foods and drinks, accommodation services and casual labourers for tasks such as excavation, drilling, accommodation and recreation services, etc. by project staff.

Negative Impacts

6.4.3 Loss of village land which is acquired for gold processing project.

Land will be required for installation of the processing plant for both gold processing and demonstration, dispensary and other facilities. Acquisition of this land for the project will cause loss of village land which could be used for other activities.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	Local	Long term	High	Possible	High

6.4.4 Community safety and cultural integrity

Gold processing plant will attract many people from different places who will interact with local people in the project area. Concerns are about the possibility of newcomers disrupting locally valued cultural practices, spread of communicable diseases and unplanned practices.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance

Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Short term	Moderate	Possible	Low

6.5 MOBILIZATION PHASE

As described in Chapter 2, this phase will be initiated immediately subsequent obtaining an EIA certificate and procurement of contractor(s). In line with the mobilization activities, the following impacts are predicted for this phase.

Positive Impacts

6.5.1 Employment opportunities

The mobilization phase is also expected to bring employment opportunities to local vendors of construction material, transported and day workers. However, such benefits are temporary, just during the mobilization phase.

Consequence	**Positive & short term**

Negative Impacts

6.5.2 Increase Traffic Load

Mobilization and transportation of construction materials and equipment will increase traffic along the Kahama-Geita roads via Msalala. Such increase have potential to cause disturbance to other road users and increase traffic jams along the road(s).

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Short term	Low	Likely	Low

6.5.3 Increase dust emission

The approach roads to the site (Bumva Road, connecting Kahama - Geita roads via Msalala) is unpaved. The increased traffic movement to and from the site will increase wheel generated dust, and windblown dust from the unpaved road to the surrounding residences. Further, the movement of vehicles and construction equipment at the site might result into fugitive emissions of dust, smoke, exhaust particulates and exhaust gases.

VEC	**Community Health and Safety**

Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Short term	High	Possible	Moderate

6.6 CONSTRUCTION PHASE

The construction phase will involve civil masonry works. Impacts from such activities although short, may be significant, and may leave residual impacts on receptors.

Positive Impacts

6.6.1 Employment opportunities

The construction of the proposed CIP will bring positive impacts to Bumva village and Segese community in general as well as well as from other places in Msalala and Kahama and the entire Lake Victoria zone. Direct employment will be in the form of unskilled (excavations, consignments, cleaning, etc.), semi-skilled (driving, masonry works, equipment and machinery operations) and skilled (engineers, accountants, administrators, etc.) personnel. Indirect employment will include business opportunities like food vending, water supply, and fuel to the Contractor during construction phase. Creation of employment chances will bring both economic and social benefits.

Consequence	**Positive & short term**

6.6.2 Income to local suppliers of natural and industrial construction materials and other supplies required by project

Procurement of local natural and industrial materials and supplies for various project purpose will increase income of local suppliers and boost local economy. Infrastructure development require input materials such as sand, stones, gravel and aggregates; cement, wood, metal, chemicals and equipment for construction purpose; fuel, oils and lubricant for operation of construction machinery and transportation vehicles; and food and domestic consumables, accommodation and other sources of livelihood for construction crew.

Consequence	**Positive & short term**

Negative Impacts

6.6.3 Air quality Deterioration

The impact will persist from the mobilization phase. The increased traffic movement to and from the site will increase wheel generated dust, and windblown dust from the unpaved road to the surrounding residences. Further, the movement of vehicles and construction equipment at the site might result into fugitive emissions of dust, smoke, exhaust particulates and exhaust gases.
These emissions will be short term and will probably be significant only at the site and adjacent sites. It is expected that smoke and exhaust emissions will immediately be dispersed and diluted in the ambient air.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Short term	High	Likely	Moderate

6.6.4 Generation of Noise and Vibration

Again, the movement of vehicles and mechanical construction equipment at the site, offloading of construction materials, and the general construction activities may elevate noise and vibration levels at the construction site. The effects of noise and vibration will be local (estimated to reach a perimeter of < 200m), short term and of low significance.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Short term	High	Likely	Low

6.6.5 Increase generation of Solid Waste

Solid wastes will be generated from construction activities such as excavation and drilling. Solid waste will also be produced from the workers' camp during this stage. The construction stage is expected to have the most solid waste production than any other stage. Expected construction wastes are such as stock piled soils, damaged materials like pipes and fittings; packaging materials etc. wastes such as food remains, plastic bags and bottles will originate from the workers' camp. Significant soil piles will result from excavation works, and this shall be used to reinstate the site after construction. Domestic solid waste collection, storage and disposal that will arise should be in accordance to the provision of the Solid Waste Management Act, 2009 and the IFC Environmental, Health and Safety Guidelines for Mining of 2007. Excavated soils shall be used as backfilling material after construction. Unused soils (if any, shall be disposed in areas recommended by either LGA or the respective municipality. Liquid waste will be treated in onsite septic tanks-soak away systems, while domestic solid wastes will be removed from the site by a subcontractor.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Short term	Moderate	Likely	Moderate

6.6.6 Population Influx and Transmission of HIV/AIDS

Construction works attracts influx of job-seekers and opportunistic businesses into any project site. Considering the current HIV/AIDS level in Tanzania, increased population (job seekers) in Bumva area may result into increased HIV-AIDS transmission rates. Another problem associated with population influx is the increased pressure and demand on available resources and social services. Effects of increased population will be short term. However, effects of HIV infections will be long term to the victims. This impact is expected to be low, since the expected number of workers is minimum. The Contractor shall enforce a code of conduct for his team, which will minimize social interactions with the community.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	Regional	Short term	Low	Possible	Moderate

6.6.7 Removal and disturbance of flora

Extraction of construction materials for the project will have direct impacts on the source of the materials (i.e. sand and stone quarry sites). Quarrying involves clearing the vegetation at the sites, excavation and transportation of the material. Thus, borrowing and quarrying activities will cause habitat change, land degradation (due to removal of fertile top soil), landscape impairment (visual intrusion) and soil erosion. Quarrying, excavation and the disposal of spoil material can destroy the economic and aesthetic value of public and/or private property including land. Some species may be affected during construction, but not to the level of extinction. Moreover, cut and fill can result to loss of vegetation dur to clearing as well as inclusion of invasive species. Nevertheless, the proposed site has less fauna, which will minimize this impact.

VEC	**Flora**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Site specific	Short term	Low	Possible	Low

6.6.8 Loss of Fauna habitat

From the study conducted, the area has low species richness. The establishment of the gold processing demonstration plant is expected to have a negligible impact on habitat loss of the Fauna present in the project site as these animals can move to the hill nearby. The loss of habitat is not expected to have a detectable impact on birds or reptiles. Impacts on Fauna by disturbing their traditional activity patterns may occur throughout the construction phase, and no further impact is expected during the plant operation. In addition, since the area is poor in terms of species richness, the recorded species are common, have 'least concern' conservation status and are not endemic to the area or the region; it is expected there will be a negligible impact of the project on the Fauna in the area.

VEC	**Fauna**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Low	Site specific	Short term	Low	Unlikely	Low

6.6.9 Occupational Safety and Health Risks

Construction workers may be exposed to various occupational hazards, creating threats to their health and safety. These are such as falling objects, running machines, ergonomic hazards, and exposure to dust, high noise and vibration levels, etc. Construction related accidents could be fatal, leaving the injured person unable to perform their work in future. The impacts could have permanent effects on the affected persons, however construction related injuries could be avoided with proper site management. Most of the predicted impacts are a result of Non-adherence to the IFC Environmental Health and Safety (EHS) guidelines and Good engineering practice.

VEC	**Health and safety**				
Consequence (c)			**Likelihood (L)**		Impact significance

Magnitude	Scale	Duration	Exposure	Probability	C x L
Moderate	Local	Short term	Very High	Likely	High

6.7 OPERATION PHASE

The operation phase of the project will involve crushing and screening of the extracted raw materials, grinding and classification, Agitation and leaching, Carbon adsorption, desorption electro-winning process and purified ingot. As explained in Chapter 2, UDSM will also conduct practical trainings to selected candidates, on Gold production. Expected impacts during these activities include:

Positive Impacts

6.7.1 New Employment opportunities

During production, it will be necessary to train and employ new staff members, next to the already existing staff at UDSM that will be involved in this project.

Consequence Positive & long term

6.7.2 Knowledge Imparted to Local Practitioners

Among other activities that will impart knowledge to the local, training sections to new workers for the proposed project will offer awareness raising activities on the importance and benefits of adopting the use of CIP technology in terms of increasing efficiency, saving operation cost and regulating the health risk that could be caused by gold production using mercury.

Consequence Positive & long term

6.7.3 Rapid urbanization of the area of following the increase of people

Once the centre opens up, population in and around the project area is going to increase due to the search for mineral processing services, and increase of related businesses like food vending, accommodation facilities, and recreational centres. This will in turn lead to the increase of the purchasing power in the area and hence stimulate commercial activities among both the local population and immigrants and improve people’s incomes.

6.7.4 Improve Efficiency for Gold Production

CIP methods will offer artisanal and small scale miners improved gold recovery rates compared to mercury-based extraction techniques. These methods involve the use of activated carbon to adsorb the gold from the ore, resulting in higher gold yields. The increased efficiency of these methods will lead to economic benefits for gold producers.

Consequence	**Positive & long term**

6.7.5 Stimulation of socio-economic activities and inducement of rapid economic growth

Gold processing plant will enable miners to recover relatively more gold from their concentrates than they used to with mercury processing. This will in turn mean increased and improved incomes for small gold miners and dealers. People who will be attracted by the high potential in business and economic opportunities brought about by the project will provide a ready market for goods and services from nearby centres like Kahama, Geita, Buseresere/Katoro etc.

6.7.6 Environmental protection

The use of mercury in gold extraction results in significant environmental harm. Mercury is a toxic substance that can contaminate water bodies and accumulate in aquatic organisms, leading to severe ecological consequences. By using CIP methods, the release of toxic mercury into the environment will be minimized or eliminated, reducing its negative impact on ecosystems. The CIP method will also be in compliance with the ESS 3(Resource efficiency and pollution prevention and management, subsection C- management of chemicals and hazardous materials). This conservation of the environment will ensure healthier water bodies (i.e. Lake Tanganyika, Lake Victoria and underground water), preserves biodiversity, and supports the overall sustainability of ecosystems.

Consequence	**Positive & long term**

6.7.7 Improve Health and safety

One of the most significant benefits of utilizing CIP methods is the elimination of health risks associated with mercury exposure. Mercury is highly toxic and can have detrimental effects on human health, including neurological and developmental disorders. Small scale miners who come into direct contact with mercury during the gold extraction process are at high risk of mercury poisoning. By switching to CIP methods, artisanal and small scale miners are provided with a safer working environment, protecting their health and well-being. Additionally, nearby communities are also safeguarded from potential health hazards associated with mercury contamination.

Consequence	**Positive & long term**

6.7.8 Regulatory compliance

The use of mercury in gold production will heavily regulated due to its adverse environmental and health effects. Many countries have implemented regulations that restrict or ban the use of mercury in mining operations. By adopting CIP methods instead, gold producers especially the artisanal and small scale miners will comply with these regulations, avoiding legal complexities and potential penalties associated with non-compliance. This enhances the reputational standing of the mining operations and demonstrates a commitment to environmentally responsible practices.

Consequence	**Positive & long term**

6.7.9 Market acceptance

Gold produced using environmentally friendly and socially responsible methods, such as CIP, aligns with international sustainability standards. There is a growing demand for ethically sourced and sustainable products, including gold. By utilizing CIP methods, artisanal and small scale miners will meet these market expectations and potentially benefit from increased market acceptance. This will result in higher demand for their gold, potentially leading to improved prices and economic benefits for the producers.

Consequence	**Positive & long term**

<u>Negative Impacts</u>

6.7.10 Air pollution (Vapours, exhausts and dust)

Air quality pollutants range from bad odours to toxic hazards and include smells of rotting organic/food wastes, sewer emissions, tobacco smoke and allergens such as moulds. Air pollution from dust is also a common problem in gold processing sites. These dust emissions result from the loading and offloading the tailings. Vehicles especially coming in and out of the site also pose a risk of dust production and exhaust emission. Exposure to gold and soil dust results in silicosis, respiratory disorders, chest problems and many other diseases.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Moderate	Local	Long term	High	Possible	Moderate

6.7.11 Noise and vibration

Setting up to the plant will generate minimal noise which will also have minimal effect. Those likely to be affected are workers on site but not neighbors as they are far from the site and sparsely populated.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Low	Site specific	Long term	Moderate	Possible	Low

6.7.12 Increase Generation and Impacts associated with poor management of waste water (i.e. from sanitary facility & TSF)

A lot of waste water is expected to come from the leaching tanks. Waste water stored in a Tailing storage facility will contain different toxic elements and compounds (i.e. copper, cadmium, zinc, lead, arsenic, chromium and cyanide) resulting from plant operation, if not well managed it may overflow on the ground and percolates in and become harmful to the environment.
Furthermore toilets are to be used by the workers and visitors. Accidental flooding of the sewerage system can flush into the storm water drainage system thereby creating biological hazards. Sewage and waste water have associated problems when they leak into the environment. Such problems include contamination of ground water and soil with harmful chemicals, poor sanitation, nuisance and associated diarrhea diseases. Poor surface drain management or large amounts of effluents may lead to blockage of drains which in turn could result in flooding and unsanitary conditions.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Long term	Moderate	Possible	Moderate

6.7.13 Soil erosion potential

Experience with mining operations reveals possibility of occurrence of the soil erosion from the stock pile of the ore materials. The proposed site lacks drainage structures. The major types of soil erosion at the project site include sheet erosion, rill erosion, gullies erosion and ravines. Usually, the top soil is removed more or less evenly with regard to sheet erosion. As sheet erosion focuses on small channels, may lead to rill erosion formations. When the volume is concentrated further, running water may erode deeper into the soil, and the rills become larger channels known as gullies. As gullies expand and deepen, they form a large feature of soil erosion which is called ravine. The survey shows that the storm water that flows through the rills turns the waterways into gullies. Soil erosion possesses high risk in formation of gullies but also pollution of the downstream water resources from the eroded materials containing unwanted chemicals or minerals.

The establishment of Gold processing project may increase soil erosion if effective conservation measures and proper storm water management methods are not adopted. It is probable that the slopes and the erosion will continue to grow, and multiple gullies erosions may merge into one very wide valley which will not influence the other development activities at the Gold Processing site.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Long term	Substantial	Possible	Substantial

6.7.14 Increase Storm water flow

Nature of the small miners operation is generally unsafe due to limited knowledge, quality of the equipment's used, method of mining activities and low capital. Mining activities are usually chemical oriented during Gold Processing. Mining activities also expose the mineral ore containing harmful pollutants to the environment. The mining waste, if not properly managed, may react with air or water to form harmful product to the environment and residents surrounding the area.

Moreover, the roofs of the buildings and the compacted working ground often lead to increased volume and velocity of storm flowing across the site due to the increase in the sealed surfaces area. Sealing of the ground surface inhibits percolation and consequent infiltration. The increased storm flow can damage existing storm drainage lines. It can also cause overflows that can cause damage to adjacent structures or facilities and can also cause soil erosion. The water may also end up stagnating in hollow places at the site and hence creating conducive breeding areas for mosquitoes and other water based vectors leading to transmission of human diseases like malaria and cholera. Run-off over gold processing plant often carry with it materials contaminated with chemicals used in gold extraction. Sometimes wastes that are transported by run off during rain period cause siltation and other pollution issues to the receiving water bodies.

There are no major water bodies close to the project site, however, occurrence of stormwater runoff to the Lake Tanganyika possess high risks of water pollution and public health if proper liquid and solid waste are not adhered.

VEC	**Community Health and Safety**	
Consequence (c)	**Likelihood (L)**	Impact significance

Magnitude	Scale	Duration	Exposure	Probability	C x L
High	District	Long term	Moderate	Possible	Moderate

6.7.15 Increase Generation of Solid wastes and Hazardous waste

Different types of solid wastes from the site will be generated throughout the plant operational phase. These will include office waste, used chemical container and bags, destroyed / broken by-products, and worn out tools among others.

VEC	Multiple				
Consequence (c)			Likelihood (L)		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Long term	Moderate	Possible	Moderate

6.7.16 Occupation Health and Safety Risks

There are three main types of occupational health and safety hazards that may be of concern. These are physical, chemical and biological. Attention must be focused on health of employees, and the neighborhood in order to attain a level of health condition that permits them to lead a healthy, socially and economically productive life.

Operations of the plant may pose health and safety risks to the employees and the surrounding community. These may arise from lack of use of protective gears/gadgets, fall into tanks, dust, noise, accidents from machinery and equipment.

VEC	Multiple				
Consequence (c)			Likelihood (L)		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	Local	Long term	Moderate	Possible	Moderate

6.7.17 Risk of Increased Transmission of STDs, COVID etc.

The establishment of CIP facility will increase interactions amongst new workers and the local, considering the current HIV-AIDS level in Tanzania, increased population (job seekers) in Bumva area may result into increased HIV-AIDS transmission rates.

VEC	**Multiple**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	Regional	Long term	Moderate	Possible	High

6.7.18 Community Cultural Integrity

The proposed project will pool people from different places within and outside Tanzania. They will have different history and culture. As a result, there is a possibility of newcomers to disrupt locally valued cultural practices, spread of communicable diseases and unplanned practices. This will include emergence of unusual activities like sex work.

VEC	**Multiple**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	Local	Long term	Moderate	Possible	Moderate

6.7.19 Disruption of local values moral standards following the presence of people from other parts of Tanzania

Every community has their moral standards on the basis of which they decide acceptable and non-acceptable thoughts and practices, for instance relating to sexuality, marriage, respect for others, dressing codes, etc. The presence of people of people of different sociocultural backgrounds—who will be looking for gold processing and related services—will introduce new moral values and or disrupt the existing ones.

6.8 DECOMMISIONING PHASE IMPACTS

The decommissioning phase will also involve fewer activities compared to the construction phase. The only activity involved will be demolishing of the facility and amenities these might lead to loss of income to the country (through revenue) and loss of jobs. Other impacts will include waste generation and occupational hazards.

6.8.1 Waste generation from decommissioning activities

During construction, temporary structures will be put so as to facilitate the construction activities. Upon completion of the construction phase, these structures would have to be removed. This activity will lead to waste generation from construction debris, used equipment's, waste materials and temporary structures. The contractor has to build a small construction campsite.

VEC	**Multiple**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Short term	Moderate	Possible	Moderate

6.8.2 Noise and Air Pollution nuisance from Dust and smoke from demolition equipment

At the end of the facility lifespan, the University of Dar Es Salaam will transfer all the components and all immovable infrastructures to local government authority for other uses or may decide to demolish or abandon the structures. Dust and noise are expected from demolition works of the structures and their impacts are considered pollution and nuisance to the environment and social setting respectively.

VEC	**Multiple**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
High	District	Short term	Moderate	Possible	Moderate

6.8.3 Pollution and nuisance due to Haphazard Disposal of toxic Waste / Abandoned Structures

Pollution and loss of aesthetics of the natural environment may result from disposal of toxic waste like cyanide is poorly managed. Also, abandonment of the structures may lead to loss of aesthetic value in the area.

VEC	**Multiple**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**

High	District	Short term	High	Possible	High

6.8.4 Loss of Employment due to Closure of the Project

When the project closes down, the people employed by the project will lose their jobs. This will have significant impacts on the employees and their families.

VEC	**Community Health and Safety**				
Consequence (c)			**Likelihood (L)**		Impact significance
Magnitude	**Scale**	**Duration**	**Exposure**	**Probability**	**C x L**
Low	Local	Long term	Moderate	Possible	Moderate

6.9 PROJECT ALTERNATIVES

This section highlights project implementation alternatives considered during the design of the project. Consideration of project alternatives is crucial in ensuring that the developer and decision-makers have a wider base from which they can choose the most appropriate option. Two types of alternatives were considered during the feasibility stage, and these are discussed hereunder. Alternatives to construction technology and construction materials shall be discussed in the detailed ESIA report.

6.9.1 No project alternative

The no project alternative entails retaining the current status quo i.e. SoMG not to establish the proposed Gold Processing Centre at Msalala District. Adopting this option would mean avoiding most of the negative effects that might be associated with the presence the factor and development center at Shinyanga region, and missing all the social economic benefits of the proposed project.

Surely, the implementation of the project has more socio economic benefits that the No project alternative.

6.9.2 Alternative Site

Nyan'gombe village, Mwakitolyo ward, Shinyanga rural district - land issues – the area has a Prospecting liscence – hence owned by a private company hence expensive, size was fine.

6.9.3 Water Supply Alternative

Alternative one: Water Supply (surface water) from the operating water utility company

Water supply from RUWASA is the option considered to be appropriate as the water supply network is within the village of the project site. Based on the field visit and stakeholder consultation, the water supply is currently not reliable, not clean and safe water supply to the proposed project.

Alternative two: Groundwater Extraction

Stakeholders and documentary review suggest that underground water is another alternative option for water supply and can supplement the water supply at the project site at such times of water shortage and scarcity. It has to be noted that before establishing the groundwater as sources of water supply, an investigation in terms of groundwater quantity and quality has to be thoroughly carried out and ascertained. Ground water investigation and well drilling have cost implications on the project. Further, based on water quality observed on the nearby shallow well, utilization of ground water will necessitate investing on water treatment plant/equipment.

Alternative three: Rainwater Harvesting

The project considered rainwater-harvesting potential as alternative source of water. It is proposed to harvest rainwater from both roof and land catchment. It will entail the design of rainwater harvesting system and underground water storage tanks. Although this may demand more investment (capital), its operation costs are relatively low. Rainwater harvesting is one of the best ways to reducing surface runoff and soil erosion. –

Alternative four: Industrial Waste Water Recycling

Recycling of Gold processing water could be another source of water for the plant. Initially, the plant could use the recycled water to supplement another source, but with time, the recycled water could be main source. The Proponent will establish a Decant water pond for plant effluents, and recycled clear water back to the process plant.

Conclustion

The proposed development shall adopt ground water extraction as the main alternative, but shall also consider rainwater harvesting and industrial waste water recycling.

6.9.4 Liquid waste Management Alternatives

Five alternatives were considered for liquid waste management, namely stabilization ponds /lagoons; constructed treatment wetland; septic tank - soakaway system for the domestic wastewater; and TSF for mineral processing plant.

6.9.5 Alternative Energy Sources

The Proponent considered three alternative sources of energy namely; electricity, diesel power generators and solar energy.

Alternative one - Electricity: As it is the case in most of developing countries, supply of electricity from national grids is not reliable as it mostly originates from hydroelectric power generators, which depend on rainfall frequency, intensity and pattern.

Alternative two - Diesel generators: These utilize fossil fuels, which tend to emit greenhouse gases especially when operated for a long time. As such, diesel generators are used as standby power supply during outages.

Alternative four - Solar energy*:* the last alternative considered was the installation of solar panels to harvest solar energy. It is intended that the solar energy be used for lighting within the buildings. It is also intended to install solar lights in various locations along the streets.

Conclusions: an evaluation of the three alternatives based on capital costs, availability of adequate supply, reliability, and environmental protection revealed the options could be used together. Therefore, it is planned to connect the site with electricity from the National grid as a basic power supply. Provisions will be made for installing solar panels in the future. However, since some machines requires high voltage, which could not be supplied by solar energy, standby generators will also be provided.

6.9.6 Alternatives building materials

It is estimated that building materials account for more than 60% of the total building cost, therefore, the selection of affordable building materials cannot be overemphasized. The project looked into a variety of building materials for different aspects of the proposed infrastructures. Architects consulted with structural engineers on the load-bearing capabilities of available materials. Five common materials namely concrete, steel, wood, masonry and stone were considered as briefly described hereunder:

Concrete: Concrete is a composite material made from fine and coarse aggregates, bonded together with cement. Its versatility, cost and strength makes it the ideal material for building foundations. It is most prefer since it can carry heavy load and withstand harsh environmental conditions its

Steel: Steel is a metal alloy of iron and carbon and often-other alloying material in its composition to make it stronger and more fracture-resistant than iron. Because it is so strong compared to its weight and size, structural engineers use it for the structural framework of tall modern buildings and large industrial facilities

Wood: Among the oldest, or perhaps *the* oldest, of building materials, wood has been used for thousands of years and has properties that make it an ideal building material—even in the days of engineered and synthetic materials.

Stones: The longest lasting building material available is the one that’s been here for thousands of years: stone. In fact, the most ancient of buildings still in existence in the world are made of stone.

Brick/masonry: Masonry construction uses individual units (such as bricks) to build structures that are usually bound together by some kind of mortar. The strongest and most commonly used masonry unit is a concrete block, which may be reinforced with steel. Glass, brick, and stone can all be used in a masonry structure

<u>*Conclusion:*</u> A team of Architects and Engineers evaluates these based on criteria such as *strength, weight and durability*, which would make it right for various uses; compatibility with National standards and testing methods that govern the use of building materials in the construction industry; consideration for structural integrity and cost and aesthetics.

6.9.7 Alternatives roofing materials

Roofing is a crucial part of the building construction. Every construction requires a stable and strong roof and should have the ability to protect the structure from natural conditions. The project proponent considered various options in terms of roofing materials, among these coated *aluminium roofing sheets* and *clay roofing tiles*. The two materials were evaluated based on costs, availability, whether resistance, longevity, flexibility and corrosion resistance.

<u>*Conclusion:*</u> Although roofing tiles score more points in terms of weather resistance, longevity and resistance to corrosion, they are known to be more expensive than aluminium roofing (i.e. per square meter). Aluminium roofing sheets score more point on capital costs, flexibility and less labor intensive during installation. Nevertheless, the contractor will opt for a more viable option.

CHAPTER SEVEN

7 ENVIRONMENTAL IMPACT MITIGATION

7.1 INTRODUCTION

This chapter provides mitigation measures for those negative impacts that were considered most likely to occur, and that have been considered to be of moderate or of major significance.

7.2 MITIGATION MEASURES DURING THE PRE-CONSTRUCTION PHASE

7.2.1 Loss of village land which is acquired for gold processing project.

Mitigation measures

- Avoid forced eviction during land acquisition.
- Ensure that resettlement activities are planned and implemented with appropriate disclosure of information, meaningful consultation, and the informed participation of those affected.
- Comply with national and international legal requirement, particularly the Village Land Act, 1999 and ESS 5 (Land Acquisition Restrictions on Land Use and Involuntary Resettlement)

7.3 MITIGATION MEASURES DURING MOBILIZATION PHASE

7.3.1 Increase dust and emissions

Mitigation measures

- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Cover all trucks hauling materials particularly sand and aggregates.

7.4 MITIGATION MEASURES DURING CONSTRUCTION PHASE

7.4.1 Air quality Deterioration

Mitigation measures

- Slow down speed of vehicle on site and access road to the site to minimize dust generation.
- The stockpiles of the earth generated during construction works should be suppressed by spraying water or water based mixtures

7.4.2 Generation of Noise and Vibration

Mitigation measures

- Conduct regular inspection of construction equipment to ensure correct and efficient operation and to keep noise levels to a minimum.
- Maintain machinery and vehicles in good running conditions by ensuring all equipment undergo regular preventive maintenance.
- Low-noise construction machinery or technology will be used as much as possible.
- Proper PPE will be provided to workers and ensure all construction workers to have noise protection equipment and to wear it at all time during high noise construction activities.
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(A), or the average maximum sound level reaches 110 dB(A).
- Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).

7.4.3 Increase generation of Solid Waste

Mitigation measures

- Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with Solid Waste Management Act, 2009s.
- Construction waste will be reused or recycled (on or offsite) to the extent possible.
- Domestic waste containers will be provided at all work sites
- All wastes produced will be collected sorted according to their physical characteristics e.g. paper, plastic, and metals, and disposed in appropriate manner.
- No waste burning or burial shall be allowed on site.

7.4.4 Population Influx and Transition of HIV/AIDS

Mitigation measures

- Infection and spread of sexually transmitted diseases (STDs) can be significantly reduced or eliminated through undertaking awareness / education programmes to personnel, and providing or making available of protective gear (e.g. condoms) to personnel.
- Establishing a worker's health protection procedures.

7.4.5 Removal and disturbance of Fauna

Mitigation measures

- Nearby habitats, particularly the hill forest that appears to harbour species whose signs of presence were noticed in the field, should not be disturbed as it acts as a refuge for the Fauna in the area.

7.4.6 Loss of Flora habitat

Mitigation measures

- Encourage and educate locals on the best ways to establish their woodlots using selected fast growing native woody species. This will lessen their dependency on such products from and around the project area.
- In order to have a successful conservation programme, the project developer should liaise with appropriate stake holders such as forestry experts/ecologists and forest department of Botany, University of Dar es Salaam and Msalala area for establishment of tree nurseries of fast growing indigenous tree species.
- During mining operations alien fruits and rehabilitation using the invasive plant species in natural vegetation should be strictly prohibited.

7.4.7 Occupational Safety and Health Risks

Mitigation measures

- The developer shall adhere to provisions of the Occupational Health and Safety Regulation, 2003.
- During construction, there will be daily kick-off meetings where safety is a key subject. Daily risks will be addressed and pro-actively discussed
- Provide proper PPEs to all workers.
- Activities labeled as "high risk" will not be executed without preliminary safety assessment; and activities will always be guided.

7.5 MITIGATION MEASURES DURING OPERATION PHASE

7.5.1 Air pollution (Vapours, exhausts and dust)

Mitigation measures

- Dispose the tailings and other wastes regularly to prevent them from accumulating at the site.
- Provide workers in areas concentrated with exhaust emissions, dust and fumes with nose masks covering the mouth and the nose; and goggles to protect the eyes.
- Run and service/maintain machinery and vehicles regularly according to the manufacturer's instructions in order to ensure efficiency in working.
- Use appropriate fuel that is free from adulteration.

- Sprinkle water on all dust-active areas to suppress dust and/or pave or apply non-toxic soil stabilizers on all unpaved access roads and parking areas.
- Sprinkle water to earthen and dusty ground before sweeping to prevent dust production.
- Supervise activities at the site especially burning and sweeping.
- Regularly check and clean or repair areas perceived to be sources of air pollution such as manholes.
- Advice workers to adhere to instruction for use of air polluting agents. For instance "DO NOT USE IN CONFINED PLACES", "DO NOT INHALE FUMES" etc.
- Advice workers to ensure indoor ventilation by opening windows and using exhaust fans to allow good air circulation into and out of the stalls and offices.
- Where possible cover all trucks hauling loose material including the gold tailings with tarpaulin and/or requiring these trucks to maintain at least two feet of freeboard.

7.5.2 Noise and vibration

Mitigation measures

i) Minimize noise at the sites and in the surrounding areas by:

- Sensitizing drivers and machine operators to switch off their engines while they are not in use especially when offloading and loading materials and to avoid hooting especially when passing near noise-sensitive areas such as health facilities, educational institutions, worship places and residential areas among other noise-restricted areas;
- Placing some noisy equipment such as generators in sound-proof rooms or in enclosures to minimize ambient noise; and
- Properly servicing and tuning construction machinery such as generators and other heavy duty equipment to reduce noise generation.
- Avoid unnecessary ignition and usage of the generator, the compressor and vehicles.

ii) Minimize the impacts of temporary construction noise and vibration by:

- Posting notices at the sites to inform people of the activities, time and day.
- Planning the construction work to take place only during the day when the neighbours are also at work and maintaining reasonable working hours of not more than 8 hours within any 24-hours working duration so as to reduce the number of complaints concerning noise from the workers and neighbours. Workers will work in shifts.
- Providing ear protective devices to workers and visitors in noisy environments to prevent high frequency noise emitted by the high frequency machines.

7.5.3 Increase Generation and Impacts associated with poor management of waste water (i.e. from sanitary facilities &Tailing Storage Facility)

Mitigation measures

- Clean sanitary facilities and sinks every day.

- Construct a soak pit for the discharge of waste water.
- Carry out regular inspections on the sewerage and waste water drainage systems to detect and repair breakages order to minimize risks of flushing that causes pollution and nuisance.

- Having a corporate tailings management policy and commitment
- Developing and implementing site-specific tailings management systems and emergency preparedness measures
- Assigning accountability and responsibility for tailings management
- Conducting annual tailings management reviews
- Developing and implementing site-specific OMS manuals
- Use the treated tailing mad to rise TSF embankment

7.5.4 Increase Storm water flow

Mitigation measures

- Install gutters and tanks to harvest and store rain water from the buildings in order to reduce run-off and use it for processing purposes.
- Design and construct curbs and channels to direct water to the lower areas.
- Design the storm drainage system in such a way that the storm does not mix with the waste water and sewerage system.
- Consult the neighbours and land owners on the lower side neighbourhood of the site to ensure that all storm drains leaving the site to the valley does not become a nuisance to them or interfere with activities therein those areas.
- Keep open all drainage lines and built no obstructions within them to prevent stagnation of water that could lead to development of breeding grounds for disease causing vectors such as mosquitoes, rats, cockroaches and lice and other vermin.

7.5.5 Increase Generation of Solid wastes and hazardous waste

a) Mitigation measures for solid waste

- Waste materials should be segregated/separated i.e. hazardous wastes, scrap metals, wood, non-biodegradable, tins and cans etc. and disposed as appropriate in legal manner.
- Adapt sound on site waste management system to ensure proper solid collection, containment and disposal.
- The plant management should consider entering into formal and structured contracts with respective handlers of the different solid wastes more so used chemical containers and bags.
- Refuse handlers should also be required to declare the destination of the wastes removed from the premises.
- Non-harmful chemical containers and bags can be reused for other purposes.

b) Mitigation measures Hazardous and electronic waste

- Training of operators and workers on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training
- Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion;
- Adhere to instructions according to material safety data sheet.
- Implementing management controls (procedures, inspections, communications, and training) to address residual risks that have not been prevented or controlled through engineering measures.
- Provide information on the types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information:
  - Name and description (e.g. composition of a mixture) of the Hazmat
  - Classification (e.g. code, class or division) of the Hazmat
  - Internationally accepted regulatory reporting threshold quantity or national equivalent of the Hazmat
  - Quantity of Hazmat used per month
  - Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)
- Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer
- Transfer of hazardous and electronic waste should be done by authorized contractor.

7.5.6 Occupation health and Safety Risks

Mitigation measures

- Workers will be provided with PPE’s such as safety foot wears, dust masks, gas masks, gumboots, gloves and respirators where appropriate and they be trained on their use.
- Medical examination before, during and after employment for employees will be ensured.
- Health and safety plan for the facility developed and refresher training of employees on first aid and safety procedures shall be conducted periodically.
- Working equipments and their postures shall be user friendly.
- Training staffs and workers on the nature of the environment they are working in and ensure awareness program concerning the effect of dust, noise, chemicals and other gaseous emissions to human health.
- Leaching tanks, barren tanks and laboratory area shall be enclosed to prevent accidents that may result from unauthorized persons entering the area.
- The consumable water shall be treated before it is supplied for consumption and its location must be far from the processing area to prevent contamination by harmful chemicals.

- There shall be speed control bumps on the road linked to the site to the main road to control speed hence limit potential accidents to animals and people.
- Well stocked first aid kits should be provided on site and somebody trained on its use be employed to take care of minor injury cases.
- Incidences and accidents records should be kept on any occurrence in the site and the company should develop an effective emergency response plan and enlighten the staff on safety measures and procedures through training and strict adherence to factories and other places of work act and all the occupational health and safety rules and regulations.
- Before the work begins every day, the safety officer/ representative shall ensure that workers and everybody on site are instructed on safety and health issues at the work place so that they can avoid occurrence of any accident to the workers and the public.
- Hygienic conditions at work place will be maintained and enforced.
- Health and safety regulations that comply with the ‘mining (safe working and occupational health) regulations, will be instituted and enforced on site
- Efficient working procedures during operation activities will be implemented as a way of minimizing near miss and incidence on the site.

7.5.7 Increased Transmission of STDs, COVID etc.

Mitigation measures

- Infection and spread of sexually transmitted diseases (STDs) can be significantly reduced or eliminated through undertaking awareness / education programmes to personnel, and providing or making available of protective gear (e.g. condoms) to personnel.
- Establishing a worker’s health protection procedures.
- Acquired immune deficiency syndrome HIV/AIDS awareness programs will be instituted according to the needs assessment due to influx of job seekers

7.6 MITIGATION MEASURES DURING DECOMISSIONING PHASE

7.6.1 Waste generation from decommissioning activities

Mitigation measure

- UDSM shall develop a detailed decommissioning plan.
- All of the demolished materials, sewage and other hazardous waste to be disposed as per national and international standard as appropriate.
- Stabilization of all project sites.
- Spoil heaps will be stabilized and revegetated.
- Care will be taken to ensure the sites is properly restored and effectively re-established.

7.6.2 Dust and Noise pollution

Mitigation Measures

- Water sprinkling shall be applied to open earth to reduce dust emission.
- Trucks transporting construction materials shall be covered if the load is dry and prone to dust emissions.
- The demolition area shall be fenced by iron sheets; this will prevent the dust at the ground to be picked up by the wind.
- Community notification shall be undertaken where appropriate where work is likely to cause dust impact on the public and nearby residents.
- Sound construction equipment, with noise sinks, shall be used
- Machine operators in various sections with significant noise levels shall be provided with noise protective gear.
- Construction equipment shall be selected, operated and maintained to minimize noise.

CHAPTER EIGHT

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 INTRODUCTION

This chapter presents measures or interventions that shall be implemented so as to minimize the potential impacts identified in the preceding chapter. The propose mitigation and enhancement measures aim at ensuring that the project is implemented in sustainable manner, and that the implementation activities have minimum negative impacts on the receiving environment (including the social environment). Further, the mitigation measures aim at ensuring that elements of the receiving environment do not affect the function ability of the project. Many of the mitigation measures put forward are nothing more than good engineering practice during construction, and adhering to best Gold extraction practices and cleaner production principles during operation phase.

8.2 IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Together with the measures, this section also proposes a plan for their implementation. The Environmental Management Plan (EMP) presented in Table 9-1 indicate institutional responsibilities, implementation timeframe, and estimated costs. The environmental and social mitigation measures shall be incorporated in the detailed engineering design, and shall form part of the contractual agreements between the client and the contractor. The Contractor shall take stock of the contents of the EMP and ensure its implementation during the construction period under close supervision of supervising firm representing UDSM. During the Operation Phase, the UDSM management will be responsible for EMP implementation.

Table 8-1:Table Environmental and Social Impact Management Plan for the Proposed Project

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
PRE-CONSTRUCTION PHASE				
Employment opportunities				
Local proximity	Recruitment of different expertise, including surveyors, engineers, planners, environmental experts	- Provide employment to locals - Pay employees as per national recognized scale - Observe labor laws, and Experts registration bodies	UDSM	NA
Loss of village land which is acquired for gold processing project.				
Local proximity	Land acquisition	- Avoid forced eviction during land acquisition. - Ensure that resettlement activities are planned and implemented with appropriate disclosure of information, meaningful consultation, and the informed participation of those affected. - Comply with national and international legal requirement, particularly the Village Land Act, 1999 and ESS 5 (Land Acquisition Restrictions on Land Use and Involuntary Resettlement)	UDSM	NA
MOBILIZATION PHASE				
Increase Traffic load				
Along the approach road	Transportation of input materials, to the project site.	- Ensure safety signs, - Ensure good traffic control system	Contractor	3,000,000
	Increased wheel generated Dust	- Manage drivers speed along the Bumva primary school road, which is currently unpaved		
Employment opportunities				
Local proximity	Recruitment of different expertise, including surveyors, engineers, planners, environmental experts	- Provide employment to locals - Pay employees as per national recognized scale Observe labor laws, and Experts registration bodies	Contractor	NA

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
Increase dust and emissions				
Local proximity	Transportation of input materials, to the project site.	- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs; - Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits; - Cover all trucks hauling materials particularly sand and aggregates.	Contractor	2,000,000
CONSTRUCTION PHASE				
Employment opportunities				
Local proximity	Recruitment of different expertise, including surveyors, engineers, planners, environmental experts	- Provide employment to locals - Pay employees as per national recognized scale Observe labor laws, and Experts registration bodies	UDSM & Contractor	NA
Air quality Deterioration				
Local proximity	Movement of vehicles and equipment operation at site.	- Regular spraying of water to dust generating and opened areas. - Vehicles transporting dust-generating materials will be covered. - Cover all stockpiles with canvas or plastic sheets during windy periods - Prohibit rubbish burning within the construction site. - All equipment shall incorporate current industry standards of dust reduction	UDSM & Contractor	3,000,000
Generation of Noise and Vibration				
Local proximity	Movement of vehicles and mechanical construction equipment at the site, offloading of construction materials	- Unnecessary use of noise generating equipment and device such as whistle, megaphones, etc. will be avoided. - Noise-generating activities will be enclosed. Orientation, labor training and awareness building will be undertaken at the construction site to ensure that workers understand compliance to national environmental requirements. - Ensuring all equipment undergo regular preventive maintenance - The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound	UDSM & Contractor	3,500,000

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
		levels reaches 140 dB(A), or the average maximum sound level reaches 110 dB(A). - Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A). - Ambient noise limits set by Standards for the Control of Noise and Vibrations Pollution Regulations, 2014 will be complied.		
Increase generation of Solid Waste, hazardous waste, and Electronic waste				
At the project site	Construction Waste	**Solid Waste** - Adhere to good house keeping - Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with Solid Waste Management Act, 2009s. - Construction waste will be reused or recycled (on or offsite) to the extent possible. - Domestic waste containers will be provided at all work sites - All wastes produced will be collected sorted according to their physical characteristics e.g. paper, plastic, and metals, and disposed in appropriate manner. - No waste burning or burial shall be allowed on site. **Hazardous and Electronic Waste** - Training of operators and workers on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training - Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion; - Adhere to instructions according to material safety data sheet. - Implementing management controls (procedures, inspections, communications, and training) to address residual risks that have not been prevented or controlled through engineering measures.	Contractor	4,500,000

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
		- Provide information on the types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information: o Name and description (e.g. composition of a mixture) of the Hazmat o Classification (e.g. code, class or division) of the Hazmat o Internationally accepted regulatory reporting threshold quantity or national equivalent of the Hazmat o Quantity of Hazmat used per month o Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity) - Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities - Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer - Transfer of hazardous and electronic waste should be done by authorized contractor.		
Population Influx and Transition of HIV/AIDS				
Local proximity	Influx of job seekers into the project site	- Control the interaction between the locals and the contractors team - Install a code of conduct for all workers - Provide HIV/AIDS awareness	Contractor	10,000,000
Removal and disturbance of flora				
At the project site	Removal of vegetation cover on the site (grass and few trees)	- Avoid unnecessary removal of vegetation - Initiate a revegetation plan asap	Contractor	1,500,000
Loss of Fauna habitat				
Local proximity	Removal of vegetation cover on the site (grass and few trees) and excavation works	- Nearby habitats, particularly the hill forest that appears to harbour species whose signs of presence were noticed in the field, should not be disturbed as it acts as a refuge for the Fauna in the area.	UDSM & Contractor	1,500,000

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
Occupational Safety and Health Risks				
Specific for the construction work force	Working with machines and equipment	- Observe and follow safety standards (OSHA standards). - Training of workers on proper use of machines and equipment's - All workers will be provided with proper PPEs. - Activities labelled as "high risk" will not be executed without preliminary safety assessment; and activities will always be guided. - All workers will be provided with portable water - Training of workers on proper use of machines and equipment's - All workplaces components, chemicals and containers at site will be labelled appropriately. - Baseline and periodical Risk assessment will be done regularly - All workers health will be examined before recruitment, periodically and on job exit. - Hire a community health and safety officer and a first aider - Provide appropriate and complete first aid kit - The developer shall adhere to provisions of the Occupational Health and Safety Regulation, 2003	UDSM & Contractor	15,000,000
Total (Pre-construction, mobilization & construction phase)				**44,000,000**
OPERATION PHASE				
New Employment opportunities				
National and local	At least 20 experts shall be employed, along with a few non experts	- Adhere to national labour laws - Ensure workers are duly registered under workers compensation funds (WCF); - Ensure workers contribution to NSSF is done as per the law - Employment opportunities should consider local people, especially for unskilled laborers.	UDSM	NA
Knowledge Imparted to Local Practitioners				
National and local	Employees and small scale miners will be trained on the new technology	- Enhance on-job training seminars - Practical training in machine & Equipment operations	UDSM	NA
Improve Efficiency for Gold Production				

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
National and local	Adopting the use of CIP technology	- Enhance proper operation of the plant facilities - Enhance good house keeping	UDSM	NA
Environmental protection				
National and local	Adopting the use of CIP technology	- Enhance proper environmental management practices - Enhance good house keeping - Educate locals on benefits of adopting CIP technology. - Regular monitoring of the project components especially the TSF levels will be done to avoid overflow - Ensure no operation waste is discharged to the environment. - Practice waste reuse, recycle where applicable	UDSM	NA
Improve Health and safety				
Local proximity	Adopting the use of CIP technology	- Enhancing proper health and safety practicing at site	UDSM	NA
Market acceptance				
National	Adopting the use of CIP technology	- Enhance gold production will practicing the best technology and environmental friendly.	UDSM	NA
Regulatory compliance				
National and local	Adopting the use of CIP technology	- Enhance proper environmental management practices	UDSM	NA
Air pollution (Vapours, exhausts and dust)				
Local proximity	Movement of vehicles and plant operation at site.	- Avoid piling up of materials prone to wind erosion. - Regular spraying of open surfaces to minimize dust - Adopt wet process whenever possible - Provide workers in areas concentrated with exhaust emissions, dust and fumes with nose masks covering the mouth and the nose; and goggles to protect the eyes. - Run and service/maintain machinery and vehicles regularly according to the manufacturer's instructions in order to ensure efficiency in working. - Use appropriate fuel that is free from adulteration.	UDSM	4,000,000
Noise and vibration				

Area of activity	**Source of Impact**	**Proposed Mitigation/Enhancement**	**Institutional Responsibility**	**Amount (TSH)**
Local proximity	Movement of vehicles and equipment operation at site (i.e. generator and crusher).	- Sensitizing drivers and machine operators to switch off their engines while they are not in use - Placing some noisy equipment such as generators in sound-proof rooms or in enclosures - Avoid unnecessary ignition and usage of the generator, the compressor and vehicles. - Providing ear protective devices to workers and visitors in noisy environments	UDSM	2,000,000
Increase Generation and Impacts associated with poor management of waste water (i.e. from sanitary facility & TSF)				
Local proximity	Generation of wastewater(sanitary facility & plant processing)	- Recycling of Plant wastewater. It is expected that the processing waste water will be stored onsite in TSF and recycled back in the plant. - Wastewater from building shall be directed to septic tanks as part of onsite sanitation - No online disposal of unthreatened effluents is allowed, only effluent meeting discharge effluents will be allowed; - Clean sanitary facilities and sinks every day. - Carry out regular inspections on the sewerage and waste water drainage systems to detect and repair breakages order to minimize risks of flushing that causes pollution and nuisance. - Having a corporate tailings management policy and commitment - Developing and implementing site-specific tailings management systems and emergency preparedness measures - Assigning accountability and responsibility for tailings management - Conducting annual tailings management reviews - Developing and implementing site-specific OMS manuals - Use the treated tailing mad to rise TSF embankment	UDSM	2,000,000
Increase Storm water flow				
Local proximity	Increase in the sealed surfaces area	- Install gutters and tanks to harvest and store rain water from the buildings. - Design and construct curbs and channels to direct water to the lower areas.	UDSM	2,000,000

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
		- Design the storm drainage system in such a way that the storm does not mix with the plants waste water and sewerage system.		
Increase Generation of Solid wastes				
Local proximity	Plant operation	- Waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with Solid Waste Management Act, 2009s. - Solid waste will be reused or recycled (on or offsite) to the extent possible. - Domestic waste containers will be provided at all work sites - All wastes produced will be collected sorted according to their physical characteristics e.g. paper, plastic, and metals, and disposed in appropriate manner. - No waste burning or burial shall be allowed on site.	UDSM	3,000,000
Occupation health and Safety Risks				
Project site	Operating the plant	- During operation, there will be daily/weekly kick-off meetings where safety is a key subject. Daily risks will be addressed and pro-actively discussed - All workers will be provided with proper PPEs. - Activities labeled as "high risk" will not be executed without preliminary safety assessment; and activities will always be guided. - All workers will be provided with portable water - Training of workers on proper use of machines and equipment's - All workplaces components, chemicals and containers at site will be labelled appropriately. - Baseline and periodical Risk assessment will be done regularly - All workers health will be examined before recruitment, periodically and on job exit. - Hire a community health and safety officer and a first aider - Provide appropriate and complete first aid kit - The developer shall adhere to provisions of the Occupational Health and Safety Regulation, 2003	UDSM	15,000,000
Increased Transmission of STDs, COVID etc.				
Local proximity	Influx of job seekers into the project site	- Install a code of conduct for all workers - Provide HIV/AIDS awareness	UDSM	10,000,000

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
Total (Operation phase impacts)				**38,000,000**
		DECOMMISIONING PHASE IMPACTS		
Waste generation from decommissioning activities				
Local proximity	Demolishing of plant infrastructure	- All materials which can be reused shall be reused - Materials that cannot be reused shall be sent to the authorized dumpsite - Adhere to Solid waste management Act 2007 and ESS 3 that require resource efficiency and pollution prevention management.	UDSM & Contractor	10,000,000
8.2.1.1 Dust and Noise Pollution				
8.2.1.2	Demolishing of plant infrastructure	- Water sprinkling shall be applied to open earth to reduce dust emission. - Trucks transporting construction materials shall be covered if the load is dry and prone to dust emissions. - The demolition area shall be fenced by iron sheets; this will prevent the dust at the ground to be picked up by the wind. - Community notification shall be undertaken where appropriate where work is likely to cause dust impact on the public and nearby residents. - Sound demolition equipment, with noise sinks, shall be used - Machine operators in various sections with significant noise levels shall be provided with noise protective gear. - Equipment shall be selected, operated and maintained to minimize noise.		
Loss of employment				
National and local	The Proponent will lay of laborers at the decommissioning phase	- Manage loss of jobs due to decommissioning early during the operation phase by ensuring skill development that can be utilized elsewhere; - Consultation, planning, communications and human resources support; - Ensure workers receive pension as per individual contracts; - Encourage entrepreneur mind amongst workers.	UDSM	NA
Loss of revenue				
National and local	Msalala DC and the government will lose	- The MDC to plan for effective management of collected revenue, and invest on other projects for more income generation.	MDC	NA

Area of activity	Source of Impact	Proposed Mitigation/Enhancement	Institutional Responsibility	Amount (TSH)
	revenue collected from the operation of the plant, and selling of Gold in the country			
Total (Decommissioning phase impacts)				**10,000,000**
GRAND TOTAL				**94,000,000**

Key

Negative Impact	**Positive Impact**

Source: Consultant Analysis, 2023

8.3 INSTITUTIONAL CAPACITY

8.3.1 The Project Proponent: UDSM

a) Management Controls

Implementation of the ESMaP is solely the responsibility of the project proponent. UDSM shall supervise and monitor all components implemented by the Contractor(s). UDSM shall also provide the necessary supervisory oversight to ensure the mitigation measures are implemented. All aspects of the proposed project will be managed to comply with National and International Environmental Standards.

In the implementation and operation of the project, UDSM shall apply a systematic approach to optimize the health, safety and environment (HSE) performance of the project and ensure that its HSE objectives and management standards are achieved. The project's HSE performance shall undergo comprehensive planning process to ensure that the management requirements identified are implemented on site through clear designation of roles and responsibilities.

The UDSM management requirements will be incorporated into implementation strategy for the project via the following key procedures and plans:

- Contractual and procedural controls on the selected Contractors (i.e. inclusion of environmental conditions in contractual documents)
- Review/auditing and reporting of environmental performance/improvement of implementation.
- Development of CIP Demostration Center specific work plans, to include:
    - Waste Management Plan
    - Health and Safety Plan
    - Emergency Response Plan (ERP)
    - Stakeholders Management Plan
    - Storm water management Plan

8.3.1.1 Waste Management Plan

A detailed Waste Management Plan should be prepared and implemented as part of the construction ESMP. The plan should detail all site-specific measures the project Contractor will implement during the construction phase to identify, collect, transport and treat all waste produced on the Worksites by its personnel. The plan should reflect consultations and agreements achieved with the local authorities.

8.3.1.2 Health and Safety Management Plan (HSMP)

The plan should detail the measures taken by the project Contractor to manage the hygiene conditions and medical care in each of the worker's camps. It should also address occupational health & safety in alignment with Labour law of Tanzania, ILO recommendations, Good Industry Practices. This plan should include (but not limited to) the following topics: (i) Health and safety policy and commitment from management, (ii) Description of organization; human resources, definition of roles and responsibilities, (iii) workers accommodation, hygiene facilities and food supply, (iv) Description of material resources including Personal Protective Equipment (PPE) to be used by workers, (v) Health and safety procedures, (vi) Risk assessment , (vii) Pollution prevention and protection, (viii) Health and safety training, (ix) Monitoring of health and safety performance, and (x) Medical checks.

8.3.1.3 Storm Water Management Plan

The plan shall provide detailed procedures for storm-water management. This plan shall reflect the collection and management of all surface runoff water through engineering design that will facilitate its proper management.

8.3.1.4 Emergency Preparedness Plan

A detailed Emergency Preparedness Plan will be prepared and implemented as part of the construction ESMP. The ESMP for Common Hazards and Emergency Situations during construction should be structured as such but not limited to:

- Identification of potential emergencies based on hazard assessment
- Procedures to respond to the identified emergency situations;
- Procedures to shut down equipment;
- Procedures to contain and limit pollution;
- Procedures for decontamination;
- Procedures for rescue and evacuation, including a designated meeting place outside the construction camps;
- Location of alarms and schedule of maintenance;
- List and location of equipment and facilities for employees responsible for responding to the emergency (fire-fighting equipment, spill response equipment, personal protection equipment for the emergency response teams, first aid kits and stations);
- Protocols for the use of the emergency equipment and facilities;
- Schedule for periodic inspection, testing and maintenance of emergency equipment;
- Clear identification of evacuation routes and meeting points;
- Schedule of trainings (drills), including with local emergency response services (e.g. fire fighters);
- Procedures for emergency drills;
- Emergency contacts and communication protocols, including with affected communities when necessary, and procedures for interaction with the government authorities;
- Procedures for periodic review and update of emergency response plans.

b) HSE Roles and Responsibilities for Key Personnel

The project's HSE performance has been and continues to undergo comprehensive planning process to ensure that the management requirements identified are implemented on site through clear designation of roles and responsibilities. The roles and responsibilities for managing environmental and social issues associated with the proposed project, rest principally on UDSM (and contractors engaged) with certain aspects assisted by the local authorities and NEMC. A summary of the HSE responsibilities for the key personnel are given:

Project Manager (PM): Responsible to ensure that adequate and suitable resources are allocated to the project to enable it to be completed, while complying fully with the requirements of the EHS Plan, and all applicable regulatory requirements.

Environmental Health and Safety Manager (EHSM): Responsible for the development of a Project EHS Plan, or approve a plan developed by others. The Plan shall be with respect to the National standards and specific for the UDSM project. Moreover, the plan will identify all EHS requirements that need to be implemented to ensure, at a minimum, compliance with applicable regulatory requirements and programs. The EHSM shall also prepare an Audit schedule for the project, and ensure audits are carried out by appropriately trained persons, with the knowledge and experience required to identify compliance issues. Ensure all audits are documented, and the report and any required corrective actions are clearly communicated to all those required to take actions. Advise and assist in the investigation of serious accidents and dangerous occurrences. Where required, assist in the reporting of all such cases to regulatory agencies. Provide EHS support to the Project Manager and ensure all required internal and external EHS reporting is completed on time

Site Manager: Responsible to ensure all elements of this project EHS plan and updates are communicated and implemented at the site.

Ensure all works, acts and emissions on site under the responsibility of UDSM, comply fully with all applicable regulatory requirements. Correct or cause to have corrected, noted or reported any EHS deficiencies.

- Ensure persons under the control of UDSM are not assigned tasks or asked to operate equipment they are not trained or competent to undertake.
- Ensure adequate security provisions are in place and fully implemented.
- The Site Manager shall ensure the resources and facilities required to implement this plan are in place before mobilization and remains in place until demobilization.
- Coordinate all activities with Customer and other Contractors/Subcontractors on the project site. Ensure all work on site only proceeds when required Safety Risk Assessments (SRAs) have been completed and reviewed by a competent person, and communicated to those who can be impacted by the hazards identified.
- Ensure all staff and visitors have the required orientation training.

Consultant: The Consultant shall ensure that those mitigation measures that are to be incorporated in the designs are completed before the implementation of the project.

8.3.2 The Contractor

The Contractor shall ensure that those mitigation measures that are to be implemented during mobilisation and construction are attended to. The Contractor shall designate among its staff /appoint an officer to act as Environmental Liaison Officer (ELO) and he/she will be responsible to ensure the environmental and social management mitigation measures are implemented during the contract period. The ELO after being provided with the required capacity shall be responsible for

- Establishing procedures, contracts, memorandum of understanding (MOU), where applicable, for interaction with authorities and local communities in Msalala DC.
- Keeping record of materials and technologies used and actions performed and reporting on the same (environmental monitoring and reporting).
- Documenting all complaints/conflicts/disagreements with details of the persons involved and the subject matter.
- Coordinating necessary studies/inspections of environmental performance (self-audits).

Project Specific Procedures identified in the EIA are:

- Emergency Response Procedures
- Waste Management Plan
- Health and Safety Manual
- Storm water management Plan

8.3.3 EHS Induction

The purpose of the induction is to encourage environmental and social responsibility among all personnel and ensure that the personnel are made fully aware of the measures required to be implemented to minimize the potential impacts on the environment, prior to the commencement of the operations. The personnel with responsibilities in specific environmental practices will be adequately trained to ensure effective implementation of the works instructions and procedures for which they have responsibilities.

8.3.4 Stakeholders

A number of stakeholders will come into play during implementation of the ESMaP. It will be the responsibility of UDSM to coordinate the involvement of relevant government authorities and service providers particularly the Segese Ward and Bumva Village, and meet related costs. Roles of some of the key stakeholders are summarized as follows:

Table 8-2; Roles of different key stakeholders

Stakeholder	**Role in ESMP implementation**
Msalala District Council offices (Community Development, Environment Management, Mining offices etc.)	- Community mobilization and awareness (material mobilisation, construction operations and related safety hazards, HIV/AIDS, etc.
Segese Ward Office & Bumva Village Office	- Involving various village leaders and committees (e.g. security, etc.) - Community mobilization, training and awareness

Stakeholder	Role in ESMP implementation
OSHA	- Regular inspection and occupational health and safety trainings
NEMC	- Ensure that the CIP Demostration Center is operated according to the EMA, 2004.
STAMICO	- Supply of chemicals to the proposed project and advice small scale miners on adopting to CIP technology.
GCLA	- Monitor all imported chemicals that shall be used during the project operations.

CHAPTER NINE

9 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1 INTRODUCTION

Monitoring refers to the systematic collection of data through a series of repetitive measurements over a long period to provide information on characteristics and functioning of environmental and social variables in specific areas over time. Four types of monitoring are also relevant to this ESIA study.

i. **Baseline monitoring** – the measurement of environmental parameters during a pre-project period and operation period to determine the nature and ranges of natural variations and where possible establish the process of change.
ii. **Impact/effect monitoring:** involves the measurement of parameters (performance indicators) during establishment, operation and decommissioning phase in order to detect and quantify environmental and social change, which may have occurred because of the project. This monitoring provides experience for future projects and lessons that can be used to improve methods and techniques.
iii. **Compliance monitoring:** takes the form of periodic sampling and continuous measurement of levels of compliance with standards and thresholds – e.g. for waste discharge, air pollution.
iv. **Enhancement/Mitigation monitoring** aims to determine the suitability and effectiveness of mitigation programmes, designed to diminish or compensate for adverse effects of the project.
v. **Product Quality Monitoring:** The company quality policy is to achieve a principle, which includes cGMP and its relevant codes of ISO 13485 and GLP when appropriate, and provide assurance to the public that each batch of diagnostic goods is safe, effective and of consistent high quality.

To ensure that mitigation measures are properly done, monitoring is essential. Table10-1 Below provides details of the attributes to be monitored, frequency and institutional responsibility. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. UDSM shall ensure that monitoring is conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data shall be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Estimated costs for environmental monitoring shall be presented in the detailed ESIA report.

9.2 PROJECT MONITORING DURING OPERATION

UDSM's environment specialists shall be responsible for reviewing civil works contracts in line with the ESMP requirements. UDSM shall play a coordination role with other key players in the implementation of the ESMP among them include contractors, local environmental authorities (e.g., Bumva village, Segese ward, Msalala District Council, STAMICO, and Ministry of Minerals.

- During the construction phase, the Environmental expert of the contractor, under the supervision of the Supervising Consultant shall prepare monthly ESMP implementation reports to be approved by the CSC.
- During the operation phase, UDSM shall hire an environmental expert, who will be responsible to conduct environmental audits and produce annual environmental and social audits reports.

These reports are useful for regulatory agencies responsible for auditing projects, including NEMC and OSHA etc. During the operation phase, UDSM will be responsible for overall project management and financial monitoring .Responsible for operational project management on site including import of equipment, local contracting issues and operation of the Gold processing plant. Environmental, Social and product quality monitoring reports shall be among the useful tools for regulatory agencies responsible for auditing projects, including NEMC and OSHA.

9.3 STAFF TRAINING

UDSM Staff shall be offered internal training from time to time as production technology may evolve. Staff in various departments will be trained on Standard Operating Procedure (SOP) in their relevant fields. The training is arranged and conducted by heads of departments or assigned personnel.

The training programs may include the following list of topics:

- Induction Training;
- Specific job Training;
- Good Practices and Quality System in Gold Production;
- Hygiene Issues (Personal and Environmental)
- Environmental, Health and Safety Issues
- Good Documentation System
- Codes of Good Conducts Training

If there shall be a need of external expert (i.e. OSHA) in delivering training session, arrangements are made by management team. The heads of departments are responsible in identifying staff training needs and shall be able to organize and supervise training sessions, including conducting induction training for new employees and specific training for staff

Table 9-1: Proposed Monitoring Plan for the proposed project

Potential Impact/Aspect	Parameter to be Monitored	Measurement Unit	Monitoring Frequency	Verifiable indicator	Means of verification	Target Level	Responsible	Cost (TSH)
MOBILIZATION PHASE								
Increased employment opportunity	Local people employed	Numbers of local people employed	Continuously during the phase	As per the Employment and Labour Relations Act, 2004	Inspection /Observation	Local community members employed	UDSM	NA
Traffic loading	Traffic jam and accidents	Number of vehicles	Monthly	Documents review, visual	Inspection /Observation	No Congestion and Zero accident	Contractor	3,000,000
CONSTRUCTION PHASE								
Employment opportunities	Local people employed	Numbers of local people employed	Continuously during the phase	As per the Employment and Labour Relations Act, 2004	Inspection /Observation	Local community members employed	UDSM	NA
Air quality Deterioration due to dust emission	PM_{10}	μg/m^3	Daily	Comparison with relevant Tanzania Standards (TZS)	Dust Measuring Equipment	60-90 for a 24 hour Average period	Contractor	1,500,000
Air quality Deterioration due to exhaust emissions	SO_2	mg/m^3	Quarterly	Comparison with relevant Tanzania Standards (TZS)	Portable Gas analyser	20 for a 24 hour Average period	Contractor	1,500,000
	NO_2	mg/m^3				200 for a 1 hour Average period		
Noise pollution	Noise level	dBA	Monthly	Guidelines for environment al noise control for Tanzania	Noise measurement	**<u>Offsite</u>** Day < 55, Night < 45 **<u>Onsite</u>** Day < 60	Contractor	1,500,000

Potential Impact/Aspect	Parameter to be Monitored	Measurement Unit	Monitoring Frequency	Verifiable indicator	Means of verification	Target Level	Responsible	Cost (TSH)
Vibration pollution	Vibration level/intensity	mm/s PPV	Quarterly	As per OSHA requirement	Vibration meter	To be within limits set by regulatory	Contractor	2,000,000
Increase generation of Solid Waste	Solid waste	Kg/day	Weekly	As per district requirement	Site inspection, Observation	Zero litter/No observed wastes on open	Contractor & Consultant, UDSM	4,500,000
Population Influx and Transition of HIV/AIDS	HIV/AIDS cases	Number of cases	Bi-annual	Visual, Interview	Voluntary testing	Zero HIV/AIDs and STDs transmission Cases	Contractor, Consultant UDSM	6,000,000
Occupational Safety and Health Risks	Noise level	dBA	Monthly	Documentation	Sound level	Zero case	Contractor & OSHA	4,000,000
	Accident/incident	Number	Daily	Documentation	Documentation, Inspection, observation, Interview	Zero case		
	PPEs, Safety signs, safety procedures, safety training done, periodic checks, inspection, medical safety	Number and type	Daily	Documentation	Inspection/Observation	All PPE provided, all signs installed, procedures followed, all medical examinations done	Contractor UDSM	9,000,000
OPERATION PHASE								
New Employment opportunities	Employees	Number	Continuously during the phase	As per the Employment and Labour Relations Act, 2004	Inspection /Observation	Local community members employed	UDSM	NA
Knowledge Imparted to Local Practitioners	Small scale miners	Numbers	Monthly	Documentation	Inspection /Observation	Small scale miners trained	UDSM	3,000,000

Potential Impact/Aspect	Parameter to be Monitored	Measurement Unit	Monitoring Frequency	Verifiable indicator	Means of verification	Target Level	Responsible	Cost (TSH)
Improve Efficiency for Gold Production	Gold recovery rate	Percentage	Daily	Documentation	Measurement/ Inspection	Maximum pant efficiency	UDSM	NA
Improve Health and safety	Small scale miners	Number	Yearly	Comparison with relevant standards	Testing	Healthy small-scale miners	UDSM	8,000,000
Air pollution (exhausts and dust)	PM_{10}	µg/m³	Daily	Comparison with relevant Tanzania Standards (TZS)	Dust monitor, Portable Gas analyser	60-90 for a 24 hour Average period	UDSM	4,500,000
	SO_2	mg/m³	Quarterly			20 for a 24 hour Average period		
	NO_2	mg/m³				200 for a 1 hour Average period		
Noise pollution	Noise level	dBA	Monthly	Guidelines for environment al noise control for Tanzania	Noise measurements	**<u>Offsite</u>** Day < 55, Night < 45 **<u>Onsite</u>** Day < 60	UDSM	1,500,000
Vibration Impact	Vibration level/intensity	mm/s PPV	Quarterly	As per OSHA requirement	Vibration meter	To be within limits set by regulatory	UDSM	2,500,000
Increase Generation and Impacts associated with poor management of wastewater (i.e. from sanitary facility & TSF	Soil quality, water quality (Heavy metal concentration, pH, dissolved oxygen, turbidity etc.)	mg/l	Bi-annual	Comparison with relevant standards	Sampling and lab analysis	No pollution	UDSM	1,000,000
Increase Generation of Solid wastes	Solid waste	Kg/day	Monthly	As per district requirement	Site inspection, Observation	Zero litter/No observed wastes on open	UDSM	3,000,000
Occupational Safety and Health Risks	Noise level	dB(A)	Monthly	As per OSHA requirement	Sound level	Zero case	UDSM & OSHA	1,500,000

Potential Impact/Aspect	Parameter to be Monitored	Measurement Unit	Monitoring Frequency	Verifiable indicator	Means of verification	Target Level	Responsible	Cost (TSH)
	Accident/incident	Number	Monthly	As per OSHA requirement	Documentation, Inspection, observation, Interview	Zero case		1,000,000
	PPEs, Safety signs, safety procedures, safety training done, periodic checks, inspection, medical safety	Number	Monthly	As per OSHA requirement	Inspection/Observation	All PPE provided, all signs installed, procedures followed, all medical examinations done	OSHA, MDC, UDSM	10,000,000
Increased Transmission of HIV/AIDS, STDs, COVID	Number and types of awareness programmes	Number	Bi-annual	Documentation	Voluntary testing	Zero HIV/AIDs and STDs transmission cases	MDC UDSM	8,000,000
Impacts on Gender Based Violence and Harassment (GBVH)	Reported GBVH cases Number and types of awareness programmes	Number	Bi-annual	Documentation and Interviews	ESS 2 and ESS 4 UDSM Gender Policy	Zero GBVH cases	UDSM	2,000,000
DECOMMISSIONING PHASE								
Loss of Employment	Pension fund remittance	Number of employees registered with NSSF	Once	Documentation	Review documents		UDSM	NA
Loss of Revenue	Revenue lost	Amount lost	Once	Documentation	Review documents		UDSM	NA

Potential Impact/Aspect	Parameter to be Monitored	Measurement Unit	Monitoring Frequency	Verifiable indicator	Means of verification	Target Level	Responsible	Cost (TSH)
Waste generation from decommissioning activities	Solid waste, liquid waste	Tones for solid wastes and liters of liquid waste	Weekly	Documentation	Inspection and observation	Zero waste observed	UDSM, MDC	5,000,000
								82,000,000

CHAPTER TEN

10 COST BENEFIT ANALYSIS OF THE PROJECT

10.1 INTRODUCTION

This chapter presents the cost benefit analysis (CBA) of the proposed CIP demonstration plant to be built at Msalala. The estimation of cost benefit analysis reflects 25 years of the project design period. The presented costs in this section are indicative and elementary qualitative description of the plant's costs and benefits. The total operation cost has considered the indicative costs for implementation of mitigation measures as well as the cost of monitoring;

10.2 BENEFITS RELATED TO THE PROJECT

Recent Government initiatives on formalization of the ASGM subsector has contributed significantly to Tanzania's gross domestic product (GDP), making this activity an important source of employment and income for miners and their dependents. The proposed project will finance the selection and application of specific cleaner technologies in place of ASM, (i.e. by providing alternative technologies) and prepare equipment to enable moving away from mercury. Overall, these investments will support the Government's efforts to formalize the ASM sector, and thus raise the GDP.

The main benefit of the project is related to benefits of ***'pollution prevention'*** and ***'exposure prevention'*** after the project implementation.

The following are some of the most valuable benefits of the project

i. Engagement during construction and operation will create new employment opportunities. This will bring direct monetary benefits to the new employees. This benefit could be quantified in terms of salaries and taxes paid to the government;
ii. Reduction of environmental (soil and water contamination) by ASM activities, reducing remediation/rehabilitation costs, reducing environmental burden; and
iii. Reduction of direct exposure to chemicals at various stages of mine processing by ASM, thus reducing the costs associated with the burden of diseases.

10.3 COSTS TO BE SAVED BY THE ADOPTION OF THE PROPOSED TECHNOLOGY

This EIA adopted a very recent Brazilan Model (Gasparinnetti *et al.*, 2024) to evaluate monetary costs of ASGM. This ESIA concentrates on impact valuations of deforestation, land degradation, and mercury contamination. The ESIA adopted values associated with environmental damage ranging from US$ 187,200 to US$ 389,200 (equivalent to TShs. 430 - 900 million) per kilogram of gold processed by ASM in Msalala, which is mostly attributable to environmental and health outcomes related to mercury contamination, which represents more than twice the market value of gold.

The ESIA furthermore, adopted the theories in Gasparinnetti *et al.*, 2024 and estimated the socioeconomic costs generated by the activities of ASM in one (1) ha of land to about US$ 0.223 billion (equivalent to TSh. 580 billion).

10.4 ENVIRONMENTAL AND SOCIAL COSTS ASSOCIATED WITH PROJECT IMPLEMENTATION

These are costs associated with implementation of the developed ESMP as well as monitoring amounts to 92,000,000 and 82,000,000 TSH respectively. The project implementation costs as per the BOQ amount to 174,000,000 TSH.

10.5 CONCLUSION

Therefore, the adoption of the proposed technology will save an average of 500 million environmental and health costs, and about 580 billion of annual social economic costs. These economic benefits are quite higher in magnitude as compared to the project implementation costs and EHS costs.

Further, there are other unquantifiable benefits associated with time savings, aesthetics, health, security and safety and higher quality gold that will be achieved. As it is the objective project and the wish of stakeholders, the CIP demonstration plant will become a centre for technology transfer to ASGM in Tnzania, thus magnifying the project benefits.

CHAPTER ELEVEN
11 DECOMMISSIONING PLAN

11.1 INTRODUCTION

Decommissioning is the formal process to remove something from active status, it is final phase in the life cycle of the project after design, construction, and operation for the planned design period. It is a process mostly involving operations such as dismantling and demolition of structures, and management of resulting demolished materials. A decommissioning plan that takes environmental issues into consideration shall be prepared by the Proponent prior to the decommissioning works.

At the end of the design life of the project, the decommissioning of the demonstration plant may be required. Decommissioning activities may involve demolition of structures and site restoration or redesigning of the project. In case of redesign or change of land use, UDSM will prepare a decommission plan and submit to Msalala District Council to NEMC for approval. UDSM will be required to re-register the any new project planned for the site.

The prepared decommissioning plan shall have the following objectives

i. Prevent or minimize adverse long term social and environmental impacts of the demonstration plant closure
ii. Create a self-sustaining ecosystem or alternate land use based on an agreed set of priorities among key stakeholders.
iii. Enable all stakeholders to have their interests considered during demonstration plant closure
iv. Ensure the process of closure occurs in an orderly, cost-effective and timely manner.
v. Ensure clear accountability and sufficient resources, for the implementation of the closure plan
vi. Establish appropriate indicators for evaluating implementation of closure process
vii. To meet agreed completion criteria to the satisfaction of the Government through the responsible Ministry.

11.2 POTENTIAL WASTE TO BE GENERATED

As part of site restoration significant amount of waste shall be generated and its quantification shall be developed in the decommissioning plan, the waste to be generated during decommissioning phase includes;

i. Structural steel waste
ii. Concrete
iii. Electrical components waste
iv. Machine parts
v. Wood

vi. Personal protective equipment waste
vii. Liquid waste including waste water, petroleum products etc
viii. Contaminated soils

11.3 POTENTIAL DECOMMISSIONING IMPACTS

Potential Impacts during the decommissioning phase include:

i. **Generation of demolition wastes (i.e. rubble);** as part of demolition process significant amount of waste shall be generated and shall require proper management for conservation of the environment and health of people.

ii. **Occupation health and safety risks associated with demolition works;** Worker involved in demolition activities shall be in high risk due to exposure to significant hazards that shall be at site such as falls, unintentional collapse of the structures, noise, vibration and dust, in addition workers may also be exposed to hazardous chemical and biological agents.

iii. **Exposure to dust generated from excavation and handling of soil stockpile;** Disturbance of the proposed project infrastructure and land as part of demolition activities shall result to generation of dust that may cause short term or long term respiratory and cardiovascular health problems to workers.

iv. **Loss of jobs by the industrial staff;** closure of the centre shall affect employed workers as their job shall end to allow demolition, this shall also affect the people depending on the employed staffs.

v. **Loss of revenue collection by the Msalala DC;** when the centre stops as part of demolition activity Msalala DC shall also lose revenues they used to gain as part of the demonstration centre operation.

vi. **Loss of jobs and business in associated services.** With the closure of the center, means all the business associated with the centre shall also stop hence other businessmen and women shall lose their jobs.

11.4 PROPOSED MITIGATION MEASURES

i. Provision of induction course and on job awareness talks on occupation health and safety to workers;
ii. Provision of relevant safety gears (including personal gears, fire protection gears, Safety Aid kit etc);
iii. Adhering to provisions in the Occupational Safety and Health Act, 2003;
iv. Applying best waste management practices so as to protect the environment.
v. Encourage introduction of small SACCOS group to burst the economy of the people especially the once lost the job.
vi. Encourage other investor to in invest in Msalala DC so as to obtain new sources of revenue

CHAPTER TWELVE

12 SUMMARY AND CONCLUSION

The Proponent, University of Dar es Salaam wishes to establish a Gold Processing demonstration centre for small scale miners on an area of 8 ha, located in Bumva village, Segese ward, Msalala district.

The proposed project has the main objectives of providing means for addressing the challenges posed by mercury, in line with Minamata Convention, by developing strategies to promote emissions reductions from mercury (including mercury-free methods, managing trade, training); and developing public health strategies to reduce exposure of miners and their communities to mercury.

Baseline data were collected and analyzed. Stakeholder’s engagement was done at the local government level and District level. Stakeholders were optimistic that the project would benefit the community, as well as other surrounding communities.

A number of environmental and social impacts were identified and analyzed by the consultants. They include loss of vegetation cover, generation of solid and liquid wastes from the establishment of the demonstration center, risks of emerging labour related conflicts and occupation health and safety issues. The EIA report contains mitigation measures for each of the identified impacts, and a plan for their implementation. With good housekeeping, cleaner production and best engineering practice, the predicted impacts could be avoided or minimized. The Proponent is committed to implement the Environmental and Social Management Plan (ESMP) in Chapter 8. An environmental and social monitoring plan is also presented in Chapter 9, to guide anybody responsible to oversee monitoring of the project activities. The Consultant is of the opinion that the project will have minimal impacts on the Environmental and social settings of the project site.

REFERENCE

1. Bishanga, E. R. (2023). *Hydrological and Hydrogeological Study for Mwamanga Co. Ltd at Bulige Village Msalala Council.*
2. Brennun, L., Davies, G., Howell, K., Newing, H., Hoffman, M., Clarke, J., Butynski, T., Davenport, T., Fimbel, R., Fimbel, C. and Hawkins, F., 2002. *African forest biodiversity: A field survey manual for vertebrates*. Earthwatch Europe.
3. COUNCIL, M. D. (2022). *MSALALA DISTRICT COUNCIL STRATEGIC PLAN (2018/2019- 2022/2023).*
4. IFC Environmental, Health and Safety (EHS) Guidelines;
5. IFC 2007. International Finance Corporation: Environmental, Health, and Safety Guidelines for Mining. World Bank Group.
6. ILO C148 Working Environment (Air Pollution, Noise & Vibration) Convention, 1977.
7. IUCN, 2016. 2016 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland. https://www.iucnredlist.org/species/22697716/93633034
8. Kingdon, J. 1998 Kingdon's Field Guide to the Mammals of Africa. Academic Press, London
9. Pedro Gasparinnetti, Leonardo Barcellos Bakker, Julia Mello Queiroz and Thais Vilela (2024). Economic valuation of artisanal small-scale gold mining impacts: A framework for value transfer application. Journal of Resources Policy. Volume 88.
10. Picker, M., 2012. Field guide to insects of South Africa. Penguin Random House South Africa.
11. Spawls, S., Howell, K. and Drewes, R., 2006. A Pocket Guide tp Reptiles and Amphibians of East Africa.
12. Spawls, S., Spawls, S., Howell, K., Hinkel, H. and Menegon, M., 2018. Field guide to East African reptiles. Bloomsbury Publishing.
13. Stevenson, T. and Fanshawe, J., 2020. Field Guide to the Birds of East Africa: Kenya, Tanzania, Uganda, Rwanda, Burundi. Bloomsbury Publishing.
14. URT, National Land Policy of 1995 (Revised in 1997);
15. URT, National Human Settlement Policy, (2000);
16. URT, National Water Policy (2002);
17. URT, The HIV Policy (2001);
18. URT, The National Investment Promotion Policy (1996);
19. URT, National Land Policy, 1996;
20. URT, National Sustainable Industrial Development Policy (1996).
21. URT, The Environmental Management Act, 2004;
22. URT, The Environmental Impact Assessment and Audit Regulations, 2005;
23. URT, Registration of Environmental Experts Regulations, 2005;
24. URT, Water Resources Management Act No. 11 (of 2009);
25. URT, Water Supply and Sanitation Act No. 12 of 2009;
26. URT, The National Land Act, 1999;
27. URT, The Land (Amendment) Act, 2004;

28. URT, The Land Tenure (Amendment) Act, 2003;
29. URT, The Occupational Health and Safety Act, (No. 4) 2003;
30. URT, The Land Use Planning Act, 2007;
31. Works Compensation Act No. 20 of 2008;
32. URT, Employment and Labour Relations Act No 6 of 2004;
33. URT, The Public Health Act of 2008;
34. URT, The HIV and AIDS (Prevention and Control) Act, 2008;
35. URT, Local Government Laws (Miscellaneous Amendments) Act, 2006;
36. URT, The Standards Act, 2009;
37. United Republic of Tanzania [URT] (2022) Tanzania Population Census
38. United Republic of Tanzania [URT] (2018) Msalala District Council Strategic Plan, 2018/2019-2024/2025
39. URT, Tanzania Investment Act, Cap. 38;
40. URT, The Environmental Management Regulations, 2007 (Water Quality Standards);
41. URT, The Tanzania Development Vision (2025);
42. URT, National Strategy for Growth and Reduction of Poverty II (2010 - 2015);
43. Convention on Biological Diversity (Rio de Janeiro Convention) (1992);
44. United Nations Framework Convention on Climate Change (Kyoto Protocol) (1992);
45. World Bank Environmental Assessment, (OP/BP 4.01)

APPENDIX

Appendix I: Detailed Record of Stakeholders Meetings

<table>
<tr><td>Issue/question/suggestion</td><td>Stakeholder (Name & position)</td><td>Response</td><td>Response by</td></tr>
<tr><td colspan="4">MEETING AT DISTRICT COMMISSIONER’S (DC) OFFICE
Date: 24th July, 2023
Time: 1030-1100HRS
Place: District Commissioner’s Office, Kahama District.
Purpose: Stakeholder Engagement for the Implementation of Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.</td></tr>
<tr><td>The District Administration is in full support of the project and highly welcomes the effort to implement it.</td><td rowspan="4">Ms. Mboni Mohamed Mhita, District Commissioner

Mr. Hamad Rajabu Mbega Administrative Secretary (DAS)</td><td rowspan="4">Noted.</td><td rowspan="4">Dr. Mugisha</td></tr>
<tr><td>Bumva village and surrounding villages are involved in small scale gold extraction and processing, activities which expose these people hazardous conditions, especially exposure to mercury and dusts because they don’t have protective gears. The centre will be an opportunity for these people to learn best practices and techniques which are environmentally and health friendly techniques.</td></tr>
<tr><td>The centre will raise people’s income in the area and save time for other important undertakings.</td></tr>
<tr><td>The project will improve women’s health who bear the burden of care of children and household members affected by hazardous mining techniques</td></tr>
<tr><td colspan="4">(a) MEETING AT REGIONAL MINES OFFICE (RMO)
Date: 24th July, 2023
Time: 1100-1120HRS
Place: RMO’s Office at Kahama.</td></tr>
</table>

<table>
<tr><td colspan="4">Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.</td></tr>
<tr><td>RMO's Office is in full support of the project and was involved in the early plans to establish this demonstration centre in Kahama District.</td><td rowspan="2">Mr. Jeremia Hango,
Ag. Regional Mines Officer

Mr. Sebstian S. Masau
Principal Mining Technician</td><td rowspan="2">Noted</td><td rowspan="2">Dr. Mugisha</td></tr>
<tr><td>Artisanal miners do not have the capacity to establish CIP plants and those who have been able to construct such plants prioritize their own ores while small scale miners are placed on the waiting list. Some are scheduled for January, 2024. So, this centre is going to very helpful to the communities of artisanal miners</td></tr>
<tr><td colspan="4">(b) MEETING AT LAKE TANGANYIKA BASIN WATER BOARD (LTBWB) AT KAHAMA
Date: 24th July, 2023
Time: 1140-1230HRS
Place: Take Tanganyika Basin Water Board Office at Kahama.
Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.</td></tr>
<tr><td>Some of the tributaries which drain to River Malagalasi and ultimately to Lake Tanganyika such as Kigosi, Nikonga, Mtundu, Moyowasi have their origins in Msalala DC and surrounding areas. So, there is a possibility of pollution happening in Msalala district to lead to deterioration of water of quality in the Lake Tanganyika Basin.</td><td rowspan="2">Mr. Juma N. Kubingwa,
Head of Office,</td><td>Noted</td><td rowspan="3">Dr. Mugisha

Eng. Pilly Anthrumani</td></tr>
<tr><td>Once the CIP plant is established will small scale miners who do mercury-based processing be forced to stop?</td><td>Yes, but the process will be gradual. People will be asked to learn the new technology and adopt it (set up their own plants).</td></tr>
<tr><td>The project developer will have to request for water use permit from the relevant authorities</td><td>Mr. Jastine Kalemile,</td><td>Noted</td></tr>
</table>

	Water Resources Engineer		
Drawings of the project layout need to be submitted to the Ministry of Water and Irrigation for approval. The ministry has the mandate of ensuring that the proposed plant is properly designed to prevent pollution of water sources.		Noted	
CIP plants are supposed to ensure zero discharge of water into the surrounding environment but the already existing plants in this area not properly designed to ensure such standards		Noted	
The proposed unit is too small to take care of all the processing needs in the area		The plant is for purposes of demonstration and training so that people can be inspired by the advantages of this pant and set up their own.	
(c) MEETING AT MSALALA DISTRICT DIRECTOR'S OFFICE **Date:** 24th July, 2023 **Time:** 1430-1500HRS **Place:** Take Tanganyika Basin Water Board Office at Kahama. **Purpose:** Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.			
Has land required for the project already been acquired?	Mr. Judica Sumari Ag. DED	Yes. The area used to be village land. The community assembly agreed to give it for the for project.	Dr. Mugisha
Will the project create employment opportunities and also facilitate access to social services like water supply, housing for health workers at the health facility close to the project area, road and electricity?		Yes the project will create employment opportunities both directly and indirectly. Apart from those who will be operating the plant, other small business opportunities will be there like food vending, kiosks etc.	

		This is a government project which will be run of cost-recovery rather than profit basis. Other services which are also provided by the government will continue to be coordinated by the respective organs. However, these organs we will be asked to consider extending their services beyond the project area to service the wider community.	
Is the project area accessible by road?		Yes, though rehabilitation is needed.	
The project will affect the natural environment in the area through clearing ad de-vegetation. Will there be assessment of the impact and revegetation after construction phase be done?	Mr. Marthad Mwinyi Khajama, Ag. DEMO	Yes. Our time has a botanist who will study the baseline conditions, identify likely impacts and suggest mitigation measures which would include revegetation.	
The project will attract people into the area and lead to population increase which in turn would lead to increased reduction of biomass for charcoal and firewood.		Noted. The project will need to work with DEMO's office fight deforestation.	
How will you handle solid waste around the project area?		Part of our team is the environmental engineer would will study and suggest how to deal with all forms of waste to be produced by the project.	
Mining activities attract many people and this leads to spread of diseases, especially sexually transmitted diseases (STDs) like HIV/AIDS and syphilis. Some people intentionally default medication and spread the virus. How will this project handle this situation?		The project will work with district health staff to sensitize people on the importance of health sexual practices. Also, occupational health and safety measures at the mining sites will be	

		made part of the training package by the demonstration centre.	
There accidents in mining sites relating to the collapse of walls of the very deep ditches (dura) upto 120 metres below the surface from which ore is extracted. In every three months 3 to 4 incidences would be report while others go unreported.		Noted. Occupational hazards and safety measures at the mining sites will be made part of the training package by the demonstration centre.	
MEETING AT RUWASA-KAHAMA DC. Date: 25th July, 2023 Time: 0900-0930HRS Place: At RUWASA Office, LTBWB Building. Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.			
RAWASA operates a water supply project whose is source is deep bore hole and elevated tank at Segese (close to Segese Centre). The source has enough water to supply to the project.		Noted and to be communicated to the developer for consideration	ESIA Team

(a) MEETING WITH SEGESE WARD DEVELOPMENT COUNCIL (WDC)
Date: 25th July, 2023
Time: 1000-1130HRS
Place: Meeting Hall, CCM Building around Segese Ward Office.
Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.

How much land will the plant take?	Kafuru Songora, Head Master, Nyerere Secondary School	Noted	Dr. Kimwaga
What are the roles of other experts (like zoologist and botanist) who are part of this team?	Segese Village Chairperson	They will study the natural environment and advise on how best	

		to prevent or mitigate project impacts. Zoologist will study wildlife (animals, birds) whereas botanist will study plants.	
Why have you not visited the project area first before this meeting so that you could use this meeting to share with us the findings of your investigation?	Honest Amani, Medical Officer Segese Dispensary	We are combining a number of approaches to get the data relating to the project area. One of such approaches is seeking stakeholders'' opinion after which we will go to the specific project area and then triangulate the information for more plausible findings.	
Cyanide is also very dangerous. He used it to suppress an anti-hill and all the ants died. Now will this chemical note kill wild and domestic animals when it is released into the environment surrounding the project?	Kafuru Songora, Head Master, Nyerere Secondary School	The plant will be designed to detoxify the waste it will be producing and recycle such products as water.	
A plant processing 20 tonnes of ore per day is too small to process all the ore produced in this area.		The plant is for purposes of demonstration and training so that people can be inspired by the advantages of this pant and set up their own.	
Some people lose their ore through theft when they submit it for processing. How will your plant deal with theft?		Arrangements will be made to prevent theft of ore.	
Will the project facilitate the supply of water (which is relatively cheaper) and electricity to their nearby community?		This is a government project which will be run of cost-recovery rather than profit basis. Other services which are also provided by the government will continue to be coordinated by the respective organs. However, these organs we will be asked to consider	

		extending their services beyond the project area to service the wider community.	
What if it happens that in the project area there is a cultural site for elders' worship?		Procedures for relocation or avoidance of such niche will be applied, in close collaboration with the respective elders.	
Every good plan is always clouded with fear and doubts but we should consider this as a favour to us by decision makers. It is also part of the implementation of CCM Manifesto of 2020 to 2025.		Noted	

(d) BUMVA VILLAGE COMMUNITY ASSEMBLY
Date: 25th July, 2023; **Time:** 1500-1700HRS
Place: Under Tree Shade, Bumva Primary School Ground
Purpose: Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.

Issue/question/suggestion		Response	Response by
As a political leader in the area called upon his people to accept the project because it was a blessing to their community. Reminded people how poorly designed processing plants had caused serious losses including loss of livestock which drank polluted water from one of the plants.	Joseph B. Manyala Ward councilor	Noted	ESIA Team
Requested that after construction phase, the area be revegetated	Sadick Selemani	Noted. to be made part of recommendations.	
Requested that the project area should be fenced			

Asked if there also be constructed an air strip		Not in the capacity of the project proponent to make such decision. Yet there is a good number of airports and airstrips in the proximity to this project area, which makes this service available.	
Said they heartedly accept and welcome the project	Flora Meshack	Noted	
Asked if the project would assist to get health workers for the dispensary at Bumva			
Wanted to know the project would start because they are very anxious about it.	Edward Malale	As above	
Will the plant have the capacity to process all the ore we produce?		As above	
We welcome the project but when will it commence?	Sarah Paulo		
The road to the project area is in bad condition. will the project habilitation it?			
Will the project not involve ore clashing using hand hummer?	James Lugonda	All the ore will be clashed by the palnt	
The project should prioritize the youth from this area in the provision of employment opportunities	Musa Hungwi	Noted. Will be communicated to the developer for adherence	
Let community members take time to think about this project? how much area will it take?	Emmanuel Mwininga	The village chairperson clarified how the area was acquired. The village assembly agreed, minutes and attendance forms were recorded and signed.	
Urged people to welcome the project. if it's a woman we will suck her milk, if it's a man they well marry our daughter	Lufega	Noted	
The project area, eight (8) acres used to be village government land. So there is no dispute.	Juma Kapalasa	Noted	

What are the opportunities which come with the project apart from provision of guarding/ security services?		Prevention of use of mercury which pollutes the environment and affects human health; improved incomes due to more efficient and effective technology reducing processing time from 3 or 4 days to 1 day and recovery of gold from 60% or 70% to above 90%.	

(e) FIRE AND RESCUE FORCE
Date: 15th April, 2024; **Time:** 1500-1600HRS
Place: Fire & Rescue Force – Kahama Office
Purpose: Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.

Issue/question/suggestion	Stakeholder (Name & position)	Response	Response by
The proposed TSF should be fenced in all sideways and on top	Insp. Justine Edwin	Noted	Eng. Colman
The entire proposed project facilities should also be fences		Noted	
There should be a reserve tank specifically for containing fire fighting water.		Noted	

(f) OCCUPATIONAL HEALTH AND SAFETY AUTHORITY
Date: 16th April, 2024; **Time:** 1200-1300HRS
Place: Occupational Health and Safety Authority – Lake Zone Office

Purpose: Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.

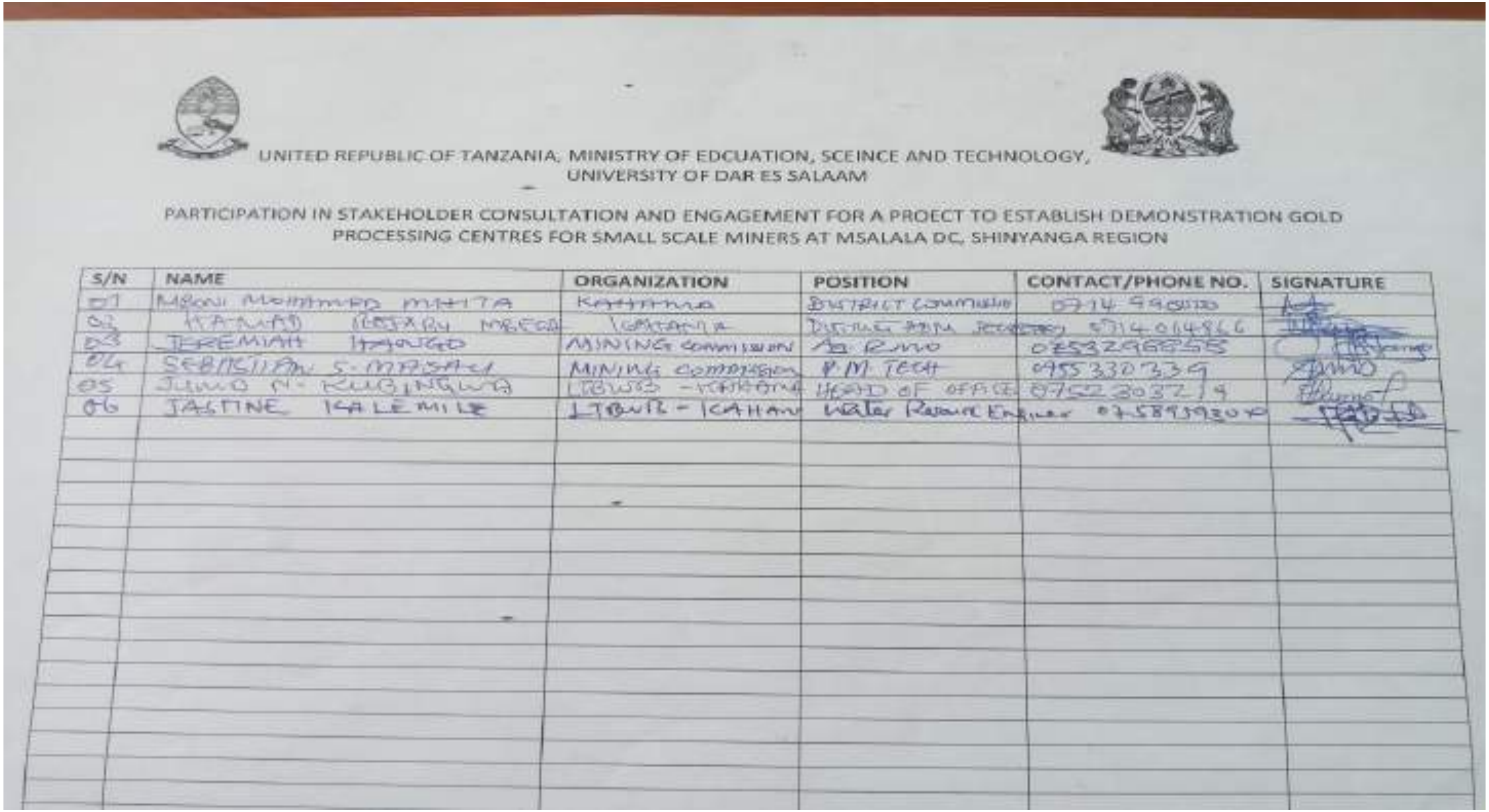
Issue/question/suggestion	Stakeholder (Name & position)	Response	Response by
The contractor should register the proposed project and pay all relevant fees before commencement of the project.	Insp. Nathanal Sanga	Noted	Eng. Colman
During operation phase, UDSM shall also register the project and ensure compliance and pay all relevant fees.		Noted	
Proper Personal Protective Equipment (PPE), clean sanitary facilities, good house keeping, and portable water ahould be provided and maintain in all project phases		Noted	

(g) GOVERNMENT CHEMIST LABORATORY AUTHORITY
Date: 16th April, 2024; **Time:** 1300-1400HRS
Place: GCLA – Lake Zone Office
Purpose: Purpose: Stakeholder Engagement for the Implementation Demonstration Centre for Gold Processing Plant Using Alternative Technology at Bumva Village, Segese Ward, Msalala DC.

Issue/question/suggestion	Stakeholder (Name & position)	Response	Response by

Chemical uses in different project component should be supervised by a proffessional person/ Expert in all project phases	Mr Protazi Lusabara	Noted	Eng. Colman
Proper chemical waste handling should be exercised and maintain highest compliance level, particularly there should be no seepage of TSF water to the environment and ensuring proper construction of TSF linning.		Noted and implementation shall comply with the instructions.	
The proposed project should be registered by GCLA	Mr. Boaz Mizar	Noted	Eng. Colman
The implementation of the proposed project should not be done in flood prone areas, and not close to residences and should have security systems		The project is not located in flood prone areas	
All chemicals should be properly labelled and there should be an Emergency Preparedness Plan (EPP)		Noted	
Since the proposed project shall involve the use of several chemicals, there should be well segregation at the store.	Same Lyochi	Noted	Eng. Colman
Hazardous wastes particularly hazardous chemical containers should be well managed in all project phases		Waste shall be managed according to national or International requirements	
The proponent should provide awareness the the close community regarding project operations and Emergency Preparedness Plan (EPP)		The proponent shall provide the awareness	

Appendix II: Signatures of Consulted Stakeholders



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S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
01	MBONI MOHAMMED MHITA	KAHAMA	DISTRICT COMMISSIONER	0714 [illegible]	
02	HAMAD [illegible] MBEGA	KAHAMA	[illegible]	0714014866	
03	JEREMIAH HANGO	MINING COMMISSION	[illegible]	0753296855	
04	SEBASTIAN S. MASALU	MINING COMMISSION	P.M. TECH	0755330339	
05	JUMA N. KUGINGWA	LBWSO - KAHAMA	HEAD OF OFFICE	0752203219	
06	JASTINE KALEMILE	LBWB - KAHAMA	Water Resource Engineer	0758939304	

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S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
01	JUDICA J. SUMARI	MSALALA DC	Ag. DED	0787762310	[signature]
02	JULIUS C. TUNGIRA	MSALALA DC	Ag CCDO	0688838808	[signature]
03	HUMPHREY PETER	MSALALA DC	AFISA UVUVI	0752109258	[signature]
04.	MARTHA MWAMI KHAJANA	MSALALA DC	AFISA MAZINGIRA	0758195288	[signature]

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02	JULIUS C. TUNGIRA	MSALALA DC	Ag CCDO	0688838808	[signature]
03	HUMPHREY PETER	MSALALA DC	AFISA UVUVI	0752109255	[signature]
04	MARTHA MWAMI KHAJANA	MSALALA DC	AFISA MAZINGIRA	0758195266	[signature]
05	Quivine R. Edwin	FIRE (KAHAMA)	CPR (MKAGUZI)	0745-449603	[signature]
06	Nathanael Shuga	OSHA	Inspector	0623785201	[signature]
07	Sane M. Lyochi	GCLA	Chemical	0759488572	[signature]
08	Protazi Lusabara	GCLA	Inspector	0734-465116	[signature]
09	Boaz Mizar	GCLA	-"-	0756767690	[signature]

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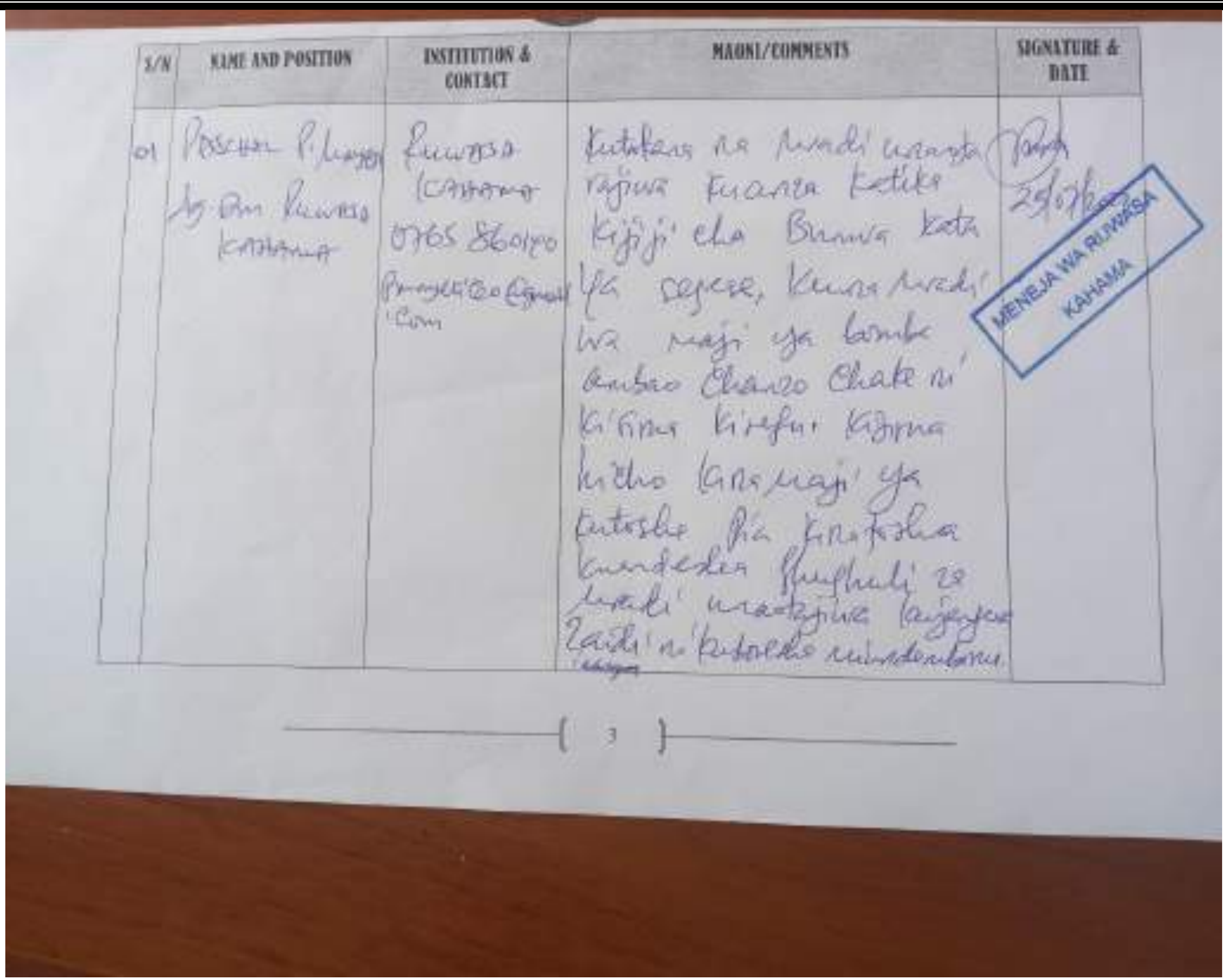
SEGESE WARD DEVELOPMENT COMMITTEE 25/07/2023

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
1	MATESIE M. MLINDA	BUMVA	M/KITI KISISI	0754674495	[illegible]
2	EDSON E. KATI	SEGESE AEK	AEK	0758011998	[illegible]
3	INSP NIMROD SWAI	POLICE	OCS-SEGESE	0713144840	[illegible]
4	SHIJA M. MANENO	SEGESE 'B' S/M	M/SHULE	0655582562	[illegible]
5	CHARLES M NYOLOBI	BUSUNGO	M/KITONGOJI	0752964760	[illegible]
6	PETER JOHN	BUSUNGO	K/SUNGU SUNGU	0755544282	[illegible]
7	MAO MSWANZALI	BUSUNGO	M/KITONGOJI	0764448417	[illegible]
8	MSENYELE NONI	SEGESE SEC	MKUU S/S	0767955064	[illegible]
9	THOMAS MAJONJO	BUSUNGO	MTENDAJI SUNGUSUNGU	0764721220	[illegible]
10	GERALD HUSSEIN	SEGESE	M/KITI	0764717854	[illegible]
11	ANTHONY NDIGELE	SEGESE	K/SUNGUSUNGU	0759304270	[illegible]
12	MAVALA DASIORY SHIJA	SEGESE	M/KITONGOJI	0746264165	[illegible]
13	PETER BASIJAN	BUMVA	M/KITI CCM KATA	0761732790	[illegible]
14	MUSA C. BUYONZA	SEGESE	K/JINSIA WANAWAKE	[illegible]	[illegible]
15	MASANJA L. MAPALALA	BUSUNGO	M/KITI	0759579138	[illegible]
16	JOHN MAHONA	WEO	AFISA	0762945079	[illegible]
17	JOHNMARY ZENAS	MWALIMU	M/SHULE	0766318542	[illegible]

0754416934



S/N	NAME AND POSITION	INSTITUTION & CONTACT	MAONI/COMMENTS	SIGNATURE & DATE
01	Paschal P. [illegible] Ag. DM Ruwasa Kahama	Ruwasa Kahama 0765 860120 [illegible]@gmail.com	Kutokana na mradi unaotarajiwa kuanza katika Kijiji cha Bumva kata ya Segese, Kuna mradi wa maji ya bomba ambao chanzo chake ni kisima kirefu [illegible] kina maji ya kutosha bila [illegible] kuendeleza shughuli za mradi unaotarajiwa [illegible] zaidi na kutoa ushirikiano.	[signature] 29/07/[illegible] MENEJA WA RUWASA KAHAMA

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– WARD DEVELOPMENT COUNCIL, SEGESE

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
01	SARAH GILBERT [illegible]	MSALALA	VEO WISOLELE	0763573695	[illegible]
02	NYASIGE C. MUGABO	MSALALA SEGESE	C.D.O	0766 600 562	[illegible]
03	[illegible]	[illegible]	[illegible]	0748-341-244	[illegible]
04	SIMON G. LUSANA	SIMSINGE BUMVA	Mkuu wa Shule	0745 417 789	[illegible]
05	PETER J. ZAKAYO	[illegible]	WATO	0712201108	[illegible]
06	SAKARI M. BALIKO	MSALALA SEGESE	VEO	0767017587	[illegible]
07	EZEKIELI KULILILWA	M SALALA SEGESE	M/kiti Kitongoji	0759500110	[illegible]
08	AMOS K. TONYONGO	MSALALA SEGESE	MJUMBE	0762228356	A.S
09	REVOCATUS INYASI	MSALALA BUMVA	KITONGOJI NDIA	0769526 888	[illegible]
10	YOHANA SAMSON	MSALALA SHILUMBA	M/kiti Kitongoji	075357115	[illegible]
11	SYLIVESTER LUBEMBEJA	MSALALA BUMVA	M Kuu wa Shule	0755504163	[illegible]
12	JOSEPH SHALUMA	MSALALA Bumva	MKITONGOJI	0765890573	[illegible]
13	SAMANO LUHIYAMA	MSALALA BUMVA	M/KITONGOJI	0762047788	[illegible]
14	HONEST ATHANAS	[illegible]	[illegible]	0765145040	[illegible]
15	MABALA SHIKALANGA	MSALALA BUMVA	MIKITI KITONGOJI	0742495358	[illegible]
16	KHANKULIA KAZUILE	BUMVA	MTWALE		K K
17	CHARLES MSOKWASI	WISOLELE	M/KITI	0744970709	[illegible]
18	MABULA KALUNGUBALE	BUMVA	KAMANDA	0745462351	M.K
19	LUCAS A. BULUGUMBA	[illegible]	[illegible]	0765140877	[illegible]
20	JOFREY J. MBULANYA	SEGESE NDH [illegible]	MWL MKUU	0759527473	[illegible]

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VILLAGE ASSEMBLY AT BUMVA 25/07/2022

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
1	MATESIE M. MLINDA	BUMVA	M/KITI KITOJI	0678674495	[illegible]
2	JOSEPH B. NANYAZA	SEGESE	AFISA MTENDAJI KATA	0763762067	[illegible]
3	GODFREY M. MTESIGWA	BUMVA	KATIBU-TAWI	0765455716	Gsigwa
4	JUMA KAPARASA	BUMVA	MJUMBE		Skafarasa
5	JOSEPH SHALUWA	BUMVA	MTENDAJI	0765890573	[illegible]
6	RICHARD MALENGEJA	BUMVA	MJUMBE	0758698402	[illegible]
7	MEAUGELA KAPALANSA	BUMVA	-11-		
8	JAMES LUFENGA	BUMVA	-11-	0755725924	[illegible]
9	PETERO Mabaka	BUMVA	- - -	0753395991	
10	MOSES LYOLA	BUMVA	- - -	0678732455	Mlyola
11	SILAS K LUCAS	BUMVA	- - -	0797416240	[illegible]
12	RUBEN JULIUS	BUMVA	- - -	0756492943	[illegible]
13	BUSALAGI KAKENGWENELE	BUMVA	- - -	0762602485	[illegible]
14	DAUDI MURUTA	BUMVA	- - -	0746467004	[illegible]
15	ABDALA JUMA	BUMVA	- - -	0626056219	AJuma
16	MASUMBUKO MATLA	BUMVA	-11- 11- - -	0744910175	[illegible]
17	ZUMA LUGWISHA	BUMVA	- - -	0699652550	[illegible]
18	JUMA BARAYI	BUMVA	-11-11- -	0768083661	[illegible]
19	MUSSA HUNGWA KANYANG	BUMVA	-11-	0745261119	M. R[illegible]
20	MABULA KALUNGUBALE [illegible]	BUMVA	-11-	0745462851	[illegible]
21	SAMWEL H. MIHAYO	BUMVA	- - -	0752074156	S. H[illegible]
22	MANGWO Edward	BUMVA	-11-	0747896637	[illegible]
23	PEPE BHUGU	BUMVA	-11-	0756185521	
24	YOHANA EDWARD	BUMVA	-11-	—	Y. Edw

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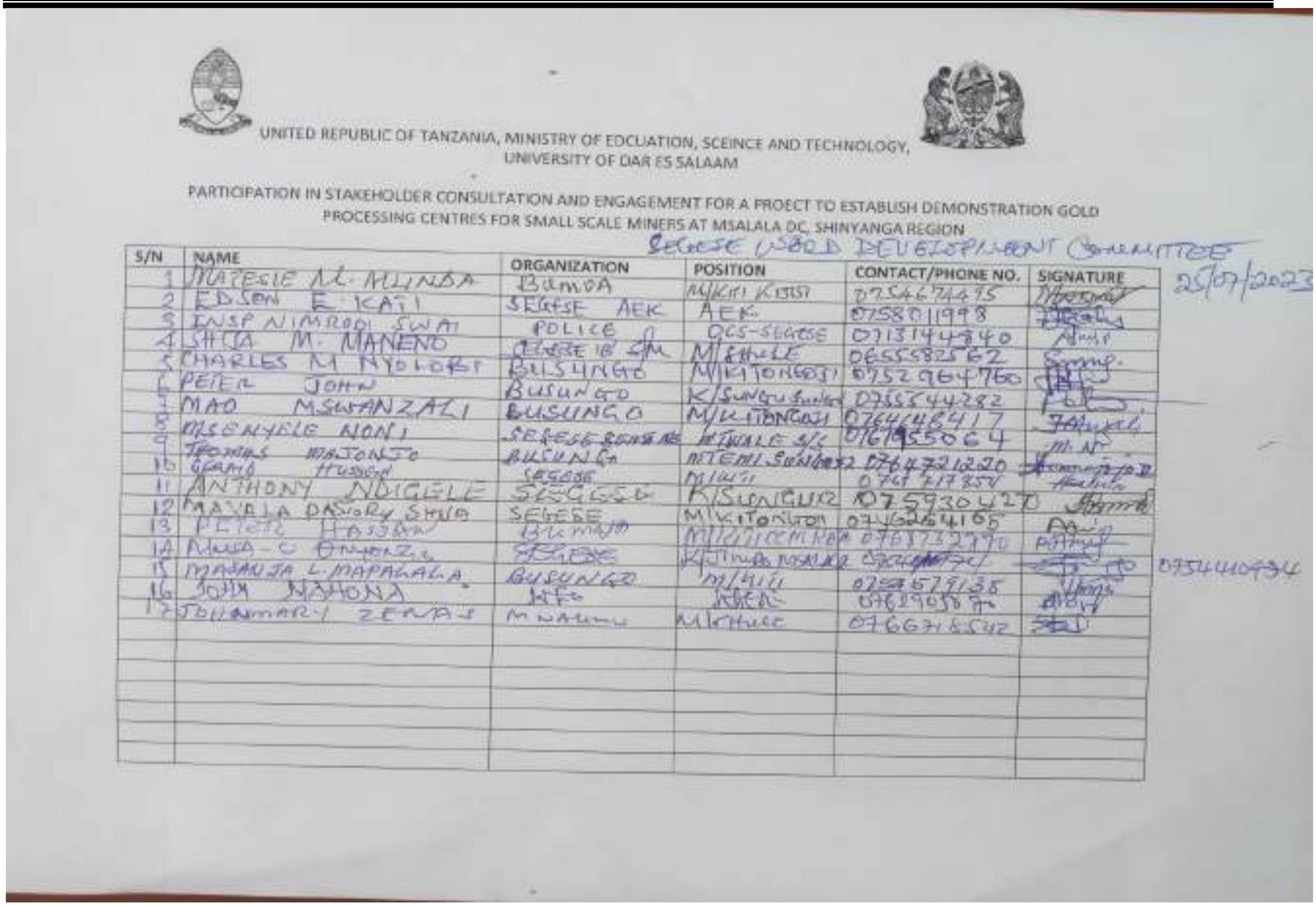
VILLAGE ASSEMBLY AT BUMVA 25/07/2023

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
25	LUCAS MULBA	BUMVA	MWANANCHI	0744043932	[illegible]
26	DAUD LUGONDA	BUMVA	—11—	0752906654	[illegible]
27	TABU MASEMBI	BUMVA	—11—	0766566105	T.M
28	YOHANA PETRO	BUMVA	—11—	0748657695	[illegible]
29	NTOBAGI KASALALI	BUMVA	—11—	0783024006	[illegible]
30	EMANUEL MWININGA	BUMVA	—11—	0759467251	Emanu
31	PASCHAL PAUL	BUMVA	—11—	0717805835	[illegible]
32	NAYILA MAYALA	BUMVA	—11—	07	[illegible]
33	SADIKI SELEMANI	BUMVA	—11—	0755451235	[illegible]
34	SHIJA L BUYIYI	BUMVA	—11—	0718346604	[illegible]
35	JOSEPH SABINI	BUMVA	—11—		J.S
36	EDWARD MAJALE	BUMVA	MWANANCHI	0756617752	E.Majale
37	MATESO BONIPHACE	BUMVA	—11—	0746208548	[illegible]
38	PHILIPO MISHMAKOTEL	BUMVA	—11—	075716[illegible]	[illegible]
39	JUMANNE LUKANDA	BUMVA	—11—		J.Lukanda
40	RAMADHAN MEDARD	BUMVA	—11—	0747914602	[illegible]



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SEGESE WARD DEVELOPMENT COMMITTEE

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
1	MATESIE M. MLINDA	BUMVA	M/KITI KIJIJI	0754674495	
2	EDSON E. KAJI	SEGESE AEK	AEK	0758011998	
3	INSP NIMRODI SWAI	POLICE	OCS-SEGESE	0713144540	
4	SHIJA M. MANENO	[illegible]	M/KITI [illegible]	0655582562	
5	CHARLES M NYOLOBI	BUSUNGO	M/KITONGOJI	0752964760	
6	PETER JOHN	BUSUNGO	K/SUNGUSUNGU	0755544282	
7	MAO MSWANZALI	BUSUNGO	M/KITONGOJI	0764486417	
8	MSENYELE NONI	SEGESE [illegible]	MTENDAJI [illegible]	0761955064	
9	THOMAS MAJONJO	BUSUNGO	MTEMI SUNGUSUNGU	0764721220	
10	[illegible] HUSSEIN	SEGESE	M/KITI	0767 717 854	
11	ANTHONY NDIGELE	SEGESE	KISUNGUZI	0759304270	
12	MAYALA DASIORY SHIJA	SEGESE	M/KITONGOJI	0746264105	
13	PETER HASSAN	BUMVA	M/KITI [illegible]	07[illegible]	
14	[illegible] C [illegible]	SEGESE	K/[illegible]	[illegible]	
15	MAJANJA L. MAPALALA	BUSUNGO	M/KITI	0759579135	
16	JOHN NAHONA	[illegible]	[illegible]	0762905[illegible]	
17	JOHNMARY ZEPHANIA	MWALIMU	M/KITI [illegible]	0766716542	

25/07/2023

0754410934

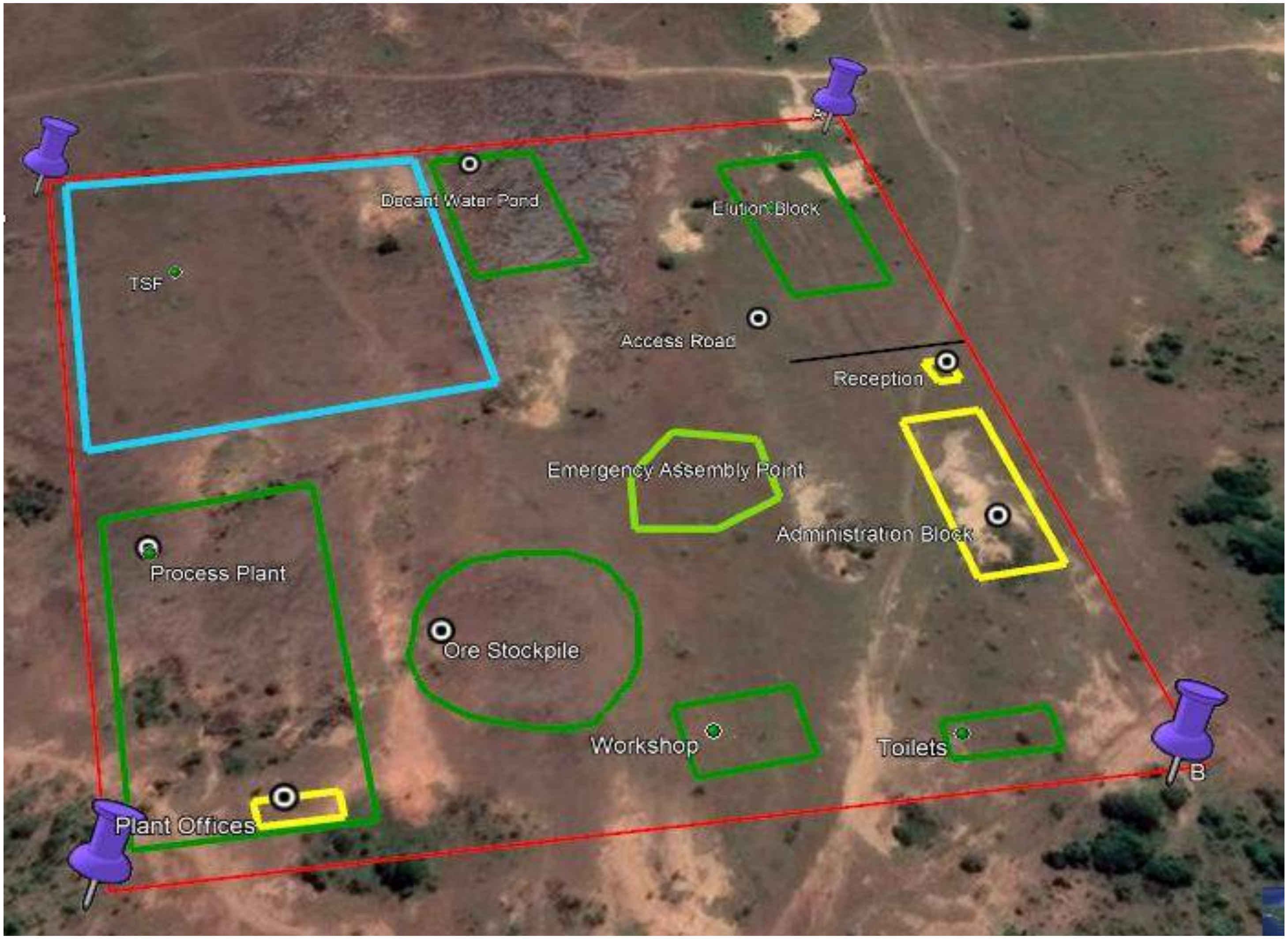
UNITED REPUBLIC OF TANZANIA, MINISTRY OF EDUCATION, SCEINCE AND TECHNOLOGY,
UNIVERSITY OF DAR ES SALAAM

PARTICIPATION IN STAKEHOLDER CONSULTATION AND ENGAGEMENT FOR A PROECT TO ESTABLISH DEMONSTRATION GOLD PROCESSING CENTRES FOR SMALL SCALE MINERS AT MSALALA DC, SHINYANGA REGION

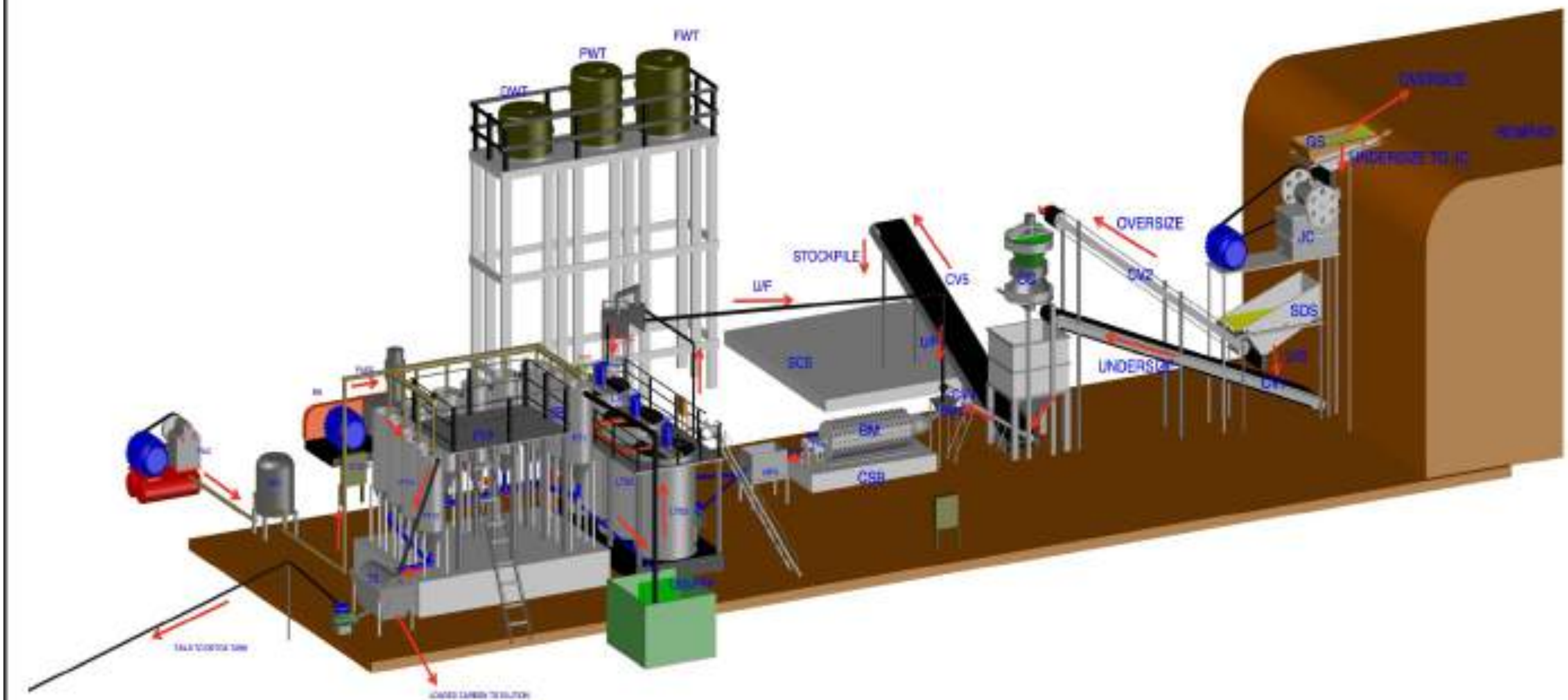
VILLAGE ASSEMBLY AT BUMVA 25/07/2[illegible]

S/N	NAME	ORGANIZATION	POSITION	CONTACT/PHONE NO.	SIGNATURE
26	MAGRETH MAKENZI	BUMVA	MJUMBE	0757818079	M. Makenzi
27	CLAUDINA AMBROSE	BUMVA	MJUMBE	0756569307	G - MARIGU
28	ASTERIA BENARD	BUMVA	MJUMBE	0763925151	[illegible]
29	LAYA DAUD	BUMVA	MJUMBE		L. Daud
30	MAGRETH IBOKU	BUMVA	MJUMBE	0757862453	M. Iboku
31	MARIAM NJILE	BUMVA	MJUMBE		M. Njile
32	SHIJA DAUD	"	"		S. Daud
33	PILI MASANJA	"	"		P. Masanja
34	REHEMA MASANJA	"	"		R. Masanja
35	SCOLASTICA MATHIAS	"	"		S. Mathias
36	NURATH NZELESA	BUMVA	"	0762235887	Nzelesa
37	EMILIANA HENRY	"	"	0767322702	[illegible]
38	REGINA JOHN	"	"		R. John
39	KHADIJA DEUS	"	"	0769431116	D. Deus
40	MARY ANDREA	BUMVA	MJUMBE	- -	M. Andrea
41	JUSTA MAIGE	BUMVA	MJUMBE	- -	J. Maige
42	ROZA TABU	BUMVA	MJUMBE	0745730979	R. Tabu
43	MASOLO BAGHUNGILO	~~[illegible]~~	MJUMBE		M. Baghungilo
44	MHALONGO JUMA	BUMVA	MJUMBE		M. Juma
45	GRECE Mabula	BUMVA	MJUMBE		G. Mabula
46	ELIZABET Malimi	BUMVA	MJUMBE		E. Malimi
47	ABIJA MLISHO	BUMVA	MJUMBE		A - Mlisho

Appendix III: Site Layout



Appendix IV: Process Plant Flowsheet

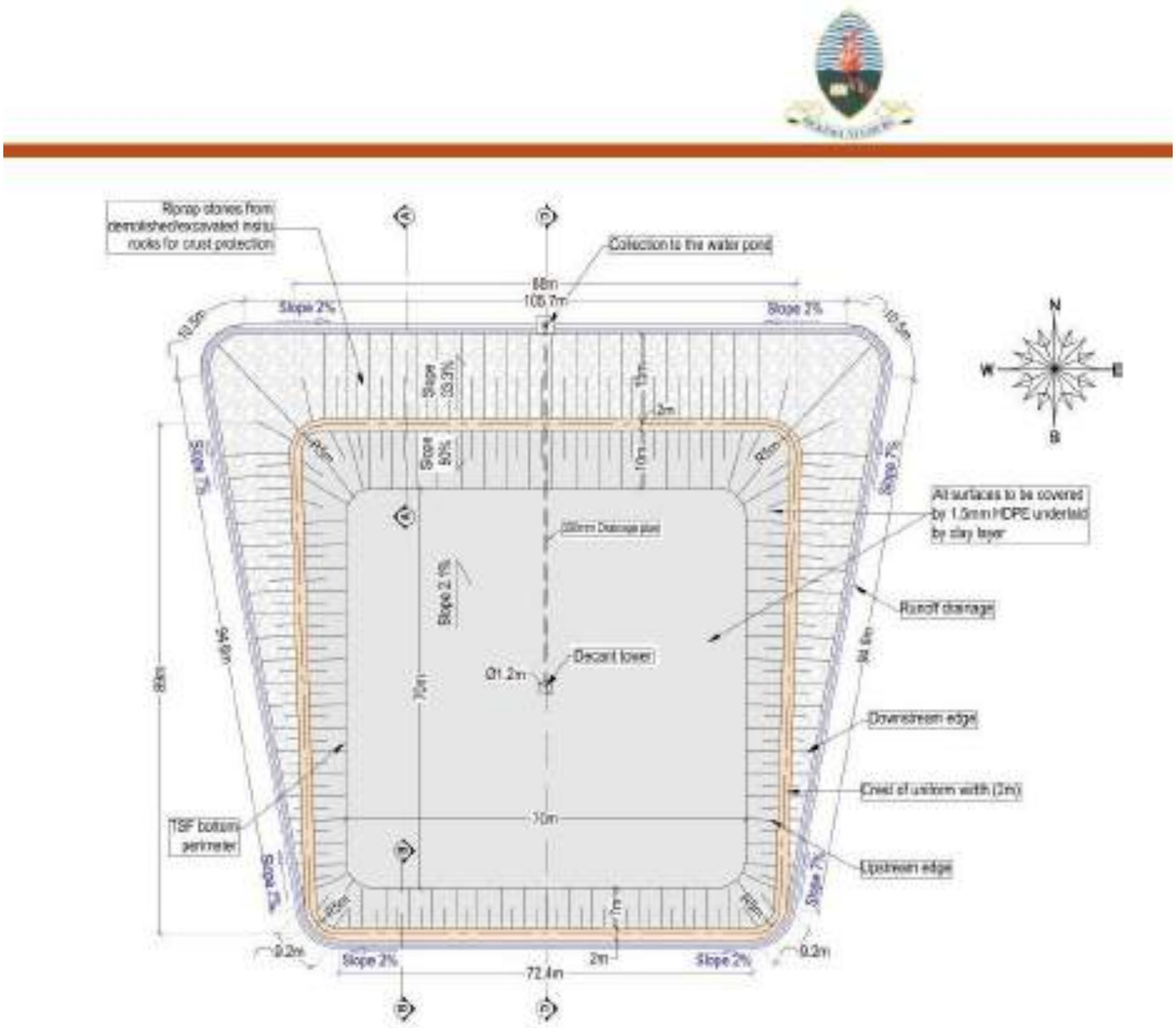


Appendix V: Mechanical Equipment List

SN	UNIT PROCESS	EQUIPMENT	SIZE	CAPACITY	POWER	QUANTITY
1	Crushing	Grizzly Screen	150x150 mm			1
		Jaw Crusher	200x300 mm	5 - 11 t/h	11 KW	1
		FEL				
		Cone Crusher	2ft, Fine	3 - 5 t/h	22 Kw	1
		Single deck Screen		5 - 11 t/h		1
		Conveyor Belt		5 - 11 t/h		5
		Mill feed chute				1
		Stockpile		30 t		
2	Grinding and Classification	Ball mill	900x3000 mm	1- 3.5 t/h	30 KW	1
		Trommel Screen	0.6x0.6 mm			
		Hydrocyclone	125 mm (dC)	8 - 15 m3/h		2
		Cyclone feed pump		10 - 22 m3/h	7.5 KW	2
		Raw water tank		10 m3		1
		Sump box				
		Centrifugal concentrator		1 t/h	1 KW	1
		VFD		50 Hz		10
3	Leaching Circuit	Tonnage box		1 m3		1
		Process water tank		20 m3		1
		Reagent Mixing tanks		100 L		2
		Reagent Mixing tanks		200 L		1
		Leaching tanks		12 m3		3
		Leaching tanks		2 m3		12
		Intertank Screen	23x24 cm	0.8 mm		12
		Intertank Screen		0.8 mm		3
		Agitators				3
		Carbon air Lifters				14
		Carbon recovery screen				1

		Carbon safety screen				1
		Air filter				1
		Air Piston Compressor				2
4	Detoxification	Detox tank		40 m^3		1
		Agitator				1
		Slurry pump		10 - 22 m^3/h	7.5 KW	2
		Reagent Mixing tank		200 L		1
		Feeding water tanks		1000 L		2
5	Elution and Electrowinning	Elution Column		1 t		1
		Acid water Tank		500 L		1
		Transfer pump		5.8 m^3/h		2
		Heat Exchanger			3 KW	12
		Elecrowinning cell	90x90 cm	300 L		1
		Digestion Chamber	2.6x2.7 m			1
		Effluent u/g tank	2.37x2.37x3 m			1
		Fume hood				1
		Smelting Furnace (Gas fired)		1200ºC		1
		Barren solution Tank (Cemented)	2.6x2.7x3 m			1

Appendix VI: TSF drawing



TSF STARTER DAM PLAN VIEW

Appendix VII: Non Technical Executive Summary (English & Swahili versions)

NON TECHNICAL EXECUTIVE SUMMARY

Environmental Impact Assessment Report for the Proposed Establishment of Mercury-Free Gold Processing Demonstration Centre For Artisanal Small-Scale Gold Miners (ASGM) at Bumva Village Segese Ward, Msalala District in Shinyanga Region.

Proponent: **School of Mines and Geosciences**
University of Dar es Salaam

Proponent's Contact: **Mobile: +255 768 384 430**
mshiutz@udsm.ac.tz / mshiutz@gmail.com
University of Dar es Salaam
P.O. Box 35052
DAR ES SALAAM

EIA Expert:

NAME	POSITION
Eng. Muganyizi Seliud	Team Leader
Dr. Zainab Katima	Chemical and Processing expert
Dr. Restituta Paul M.	Environmental expert
Dr Mary Kayombo	Hydrologist
Dr Heriel Moshi	Botanist
Dr Steven Temu	Zoologist
Dr Lucius Mugisha	Sociologist
Eng. Colman Richard	GIS Expert

The project involves the construction of a Mercury-Free Gold Processing Demonstration Centre for Artisanal Small-Scale Gold Miners (ASGM) at Bumva Village Segese Ward, Msalala District in Shinyanga Region that shall adopt CIP technology for extraction of Gold from Small Scale Miner's Ores with a capacity of extracting upto 20tons/day. The facility will consist of Administration Block, Laboratory building, Workshop and Store, Ore Stockpile, Processing Plant, Elution Area, Tailing Storage Facility (TSF), Decant Water Pond, Power room, Fresh water storage facility, Kitchen and Canteen, Access Road, Changing room, Sanitary facility, Monitoring borehole, Light and security system, and Emergency Assembly Point, to be developed in 8 acres piece of land. Generally, the project activities are comprised of the design, mobilization, construction and operation and maintenance of civil structures that represent all key unit functions of the demonstration center. The capital investment cost for the development of the proposed Mercury-Free Gold Processing Demonstration Centre facilities is estimated at 350,000 USD covering the consultancy fees, construction/installation materials, equipment, labour charges and furniture.

The identification of impact was based on cause-effect interactions between the projects' activities and the existing relevant baseline conditions (Valued Environmental and Social Receptors, (VECs) being physical, chemical, biological, built, or human. Impacts identification is extended through the entire project cycle. Stakeholder involvement was made to ensure the quality, comprehensiveness and effectiveness of the ESIA study as well as to ensure that various groups' views are adequately taken into consideration in the decision-making process. The identification of stakeholders was based on a Stakeholder's Engagement Plan (SEP) that articulated the role and relevance of an institution, authority, agency, group or individual to the proposed project. Key stakeholders who were consulted include the District Commissioner's Office, Regional Mines Office (RMO), Lake Tanganyika Basin Water Board, Msalala District Council, RUWASA-Kahama District, Occupational Safety and Health Authority (OSHA) – Lake Zone, Government Chemist Laboratory Authority (GCLA), Fire & Recsue Force – Kahama, Segese Ward Development Council (WDC), and Bumva Village Community Assembly.

Some of the identified environmental impacts include soil disturbance during the design, mobilization, construction and decommissioning phase which may result in soil erosion and siltation if appropriate measures are not taken. Noise pollution is likely to occur resulting from project activities and machines and equipment run as well as increasing road operation and traffic flow. However, the project will bring a number of opportunities due to purchasing of supplies and services during the project implementation. Employment opportunities and income to local communities as the project will result into job creation for skilled and unskilled labourers.

Mitigation measures have been recommended to match the predicted impacts and possible prevention, avoidance and corrective measures. The Environmental and Social Management Plan (ESMaP) sets the "environmental conditions" that will be abided by project proponents during the project's implementation. The Environmental Monitoring Plan (ESMoP) has been proposed for the project, intended to ensure mitigation measures are implemented in accordance with regulations and standards. Since the demonstration center will be constructed in Bumva Village, the cost for implementation of the ESMoP during operation and maintenance will be part of the UDSM operation cost. The proposed Mercury-Free Gold Processing Demonstration Centre for Artisanal Small-Scale Gold Miners (ASGM) is anticipated to last for a minimum of 20 years based on its design. However, the University's operation may come to an end when natural disasters wash away the infrastructures or when the government decides to change the land use for the entire project area. In those circumstances the UDSM may decide to decommission the Mercury-Free Gold Processing Demonstration Centre facilities at Bumva Village the assessment provides a preliminary decommissioning plan for the proposed Demonstration Centre facilities. It establishes feasible decommissioning activities that can be accomplished without undue risk to the health and safety of the public, and decommissioning personnel and without adverse effects on the environment.

SWAHILI VERSION

MUHTASARI USIO WA KITAALAM

Ripoti ya Tathmini ya Athari za Mazingira kwa Kuanzishwa kwa Kituo cha Maonyesho ya Usindikaji wa Dhahabu Yasiyotumia Zebaki kwa Wachimbaji Wadogo wa Dhahabu wa Kisanii (ASGM) katika Kijiji cha Bumva, Kata ya Segese, Wilaya ya Msalala, Mkoa wa Shinyanga.

Mwombaji: **Shule ya Madini na Sayansi ya Ardhi**
Chuo Kikuu cha Dar es Salaam

Mawasiliano ya Mwombaji : **Mawasiliano: +255 768 384 430**
mshiutz@udsm.ac.tz / mshiutz@gmail.com
Chuo Kikuu cha Dar es Salaam
S.L.P 35052
DAR ES SALAAM

EIA Expert:

JINA	NAFASI
Mhandisi. Muganyizi Seliud	Kiongozi wa Timu
Dkt. Zainab Katima	Mtaalam wa Kemikali na Usindikaji
Dkt. Restituta Paul M.	Mtaalam wa Mazingira
Dkt. Mary Kayombo	Mtaalam wa Hidrolojia
Dkt. Heriel Moshi	Mtaalam wa Mimea
Dkt. Steven Temu	Mtaalam wa Wanyama
Dkt. Lucius Mugisha	Mtaalam wa Jamii
Mhandisi. Colman Richard	Mtaalam wa GIS (Mfumo wa Taarifa za Kijiografia)

MUHTASARI USIO WA KITAALAM

Mradi huu unajumuisha ujenzi wa Kituo cha Maonyesho ya Usindikaji wa Dhahabu Yasiyotumia Zebaki kwa Wachimbaji Wadogo wa Dhahabu wa Kisanii (ASGM) katika Kijiji cha Bumva, Kata ya Segese, Wilaya ya Msalala katika Mkoa wa Shinyanga ambacho kitatumia teknolojia ya CIP kwa uchimbaji wa Dhahabu kutoka kwa Madini ya Wachimbaji wa Kiwango cha Chini na uwezo wa kuchenjua hadi tani

20 kwa siku. Kituo hicho kitajumuisha Bloku ya Utawala, Jengo la Maabara, Karakana na Ghala, Hifadhi ya Madini, Kiwanda cha Usindikaji, Eneo la Utoaji, Mahali pa Kuhifadhi Maji ya Mkondo, Chumba cha Umeme, Fasiliti ya Uhifadhi wa Maji Safi, Jiko na Mghahawa, Barabara ya Kufikia, Chumba cha Kubadilisha, Fasiliti za Usafi, Kibuya cha Kufuatilia, Mfumo wa Mwanga na Usalama, na Mahali pa Mkusanyiko wa Dharura, ambavyo vitajengwa katika eneo la ekari 8. Kwa ujumla, shughuli za mradi zinajumuisha kubuni, kuhama, ujenzi, na uendeshaji na matengenezo ya miundo ya kiraia inayowakilisha kazi muhimu zote za kituo cha maonyesho. Gharama ya uwekezaji wa mtaji kwa maendeleo ya vifaa vya Kituo cha Maonyesho ya Usindikaji wa Dhahabu Yasiyotumia Zebaki inakadiriwa kuwa dola za Kimarekani 350,000 kufunika ada za ushauri, vifaa vya ujenzi/usanikishaji, vifaa, gharama za kazi, na samani.

Ugunduzi wa athari ulizingatia uhusiano kati ya shughuli za miradi na hali ya msingi iliyopo (Receptors za Mazingira na Jamii Zilizotambuliwa, (VECs) ikiwa ni pamoja na vipengele vya kimwili, kikemia, kibaiolojia, kilijengwa, au kibinadamu. Ufahamu wa athari unazidi kupitia mzunguko mzima wa mradi. Ushiriki wa wadau ulifanywa ili kuhakikisha ubora, umakini, na ufanisi wa utafiti wa ESIA pamoja na kuhakikisha maoni ya vikundi mbalimbali yanachukuliwa ipasavyo katika mchakato wa maamuzi. Ugunduzi wa wadau ulizingatia Mpango wa Kushirikiana na Wadau (SEP) uliotamka jukumu na umuhimu wa taasisi, mamlaka, shirika, kikundi au mtu binafsi kwa mradi uliopendekezwa. Wadau muhimu waliokutwa ni pamoja na Ofisi ya Mkuu wa Wilaya, Ofisi ya Madini ya Mkoa (RMO), Bodi ya Maji ya Bonde la Ziwa Tanganyika, Baraza la Wilaya la Msalala, RUWASA-Kahama, Mamlaka ya Usalama na Afya Kazini (OSHA) - Mkoa wa Ziwa, Mamlaka ya Maabara ya Kemia ya Serikali (GCLA), Jeshi la Moto na Uokoaji - Kahama, Baraza la Maendeleo la Kata ya Segese (WDC), na Jumuiya ya Kijiji cha Bumva.

Baadhi ya athari za mazingira zilizotambuliwa ni pamoja na kuchafua ardhi wakati wa hatua za kubuni, kuhama, ujenzi, na kufuta ambayo inaweza kusababisha mmomonyoko wa udongo na kuziba ikiwa hatua sahihi hazitachukuliwa. Uchafuzi wa kelele unaweza kutokea kutokana na shughuli za mradi na mashine na vifaa vya kukimbia pamoja na kuongezeka kwa uendeshaji wa barabara na mzunguko wa trafiki. Hata hivyo, mradi utaleta fursa kadhaa kutokana na ununuzi wa vifaa na huduma wakati wa utekelezaji wa mradi. Fursa za ajira na kipato kwa jamii za ndani kwani mradi utasababisha uundaji wa ajira kwa wafanyakazi wenye ujuzi na wasio na ujuzi.

Hatua za kupunguza zimerekebishwa ili kukidhi athari zilizotabiriwa na kuzuia, kuepuka na kurekebisha hatua zinazowezekana. Mpango wa Usimamizi wa Mazingira na Kijamii (ESMaP) unaweka "hali za mazingira" ambazo zitazingatiwa na waendeshaji wa mradi wakati wa utekelezaji wa mradi. Mpango wa Kufuatilia Mazingira (ESMoP) umependekezwa kwa mradi, lengo likiwa kuhakikisha hatua za kupunguza zinatekelezwa kulingana na kanuni na viwango. Kwa kuwa kituo cha maonyesho kitajengwa katika Kijiji cha Bumva, gharama za utekelezaji wa ESMoP wakati wa uendeshaji na matengenezo zitakuwa sehemu ya gharama ya uendeshaji wa UDSM. Kituo cha Maonyesho ya Usindikaji wa Dhahabu Bila Hewa ya Zebaki kilipendekezwa kwa Wachimbaji Wadogo wa Dhahabu wa Kisanii (ASGM) kinatarajiwa kudumu kwa angalau miaka 20 kulingana na muundo wake. Walakini, uendeshaji wa Chuo Kikuu unaweza kufika mwisho wakati majanga ya asili yanapoa miundombinu au wakati serikali inaamua kubadilisha matumizi ya ardhi kwa eneo lote la mradi. Katika hali hizo, UDSM inaweza kuamua kufuta vituo vya Kituo cha Maonyesho ya Usindikaji wa Dhahabu Bila Hewa ya Zebaki huko Kijiji cha Bumva tathmini hutoa mpango wa awali wa kufuta kwa vifaa vya Kituo cha Maonyesho vilivyopendekezwa. Inaweka shughuli za kufutwa zinazowezekana ambazo zinaweza kutekelezwa bila hatari kubwa kwa afya na usalama wa umma, na wafanyikazi wa kufuta na bila athari mbaya kwa mazingira.

Appendix VIII: Proof of Land Ownership

Fomu ya Ardhi ya Vijiji Na. 21

Namba ya Hati ya Hakimiliki......................

JAMHURI YA MUUNGANO WA TANZANIA

SHERIA YA ARDHI YA VIJIJI, 1999
(Na. 5 ya 1999)

HATI YA HAKIMILIKI YA KIMILA

(CHINI YA FUNGU LA 25)

Leo tarehe......15th..........mwezi...DECEMBER......mwaka......2023..........

Hii ni kuthibitisha kwamba Halmashauri ya Kijiji cha **BUMVA** (Jina na anwani) **S. L. P .16 KAHAMA, SHINYANGA** imetoa kwa (Jina la Mkazi) **CHUO KIKUU CHA DAR ES SALAAM, S.L.P 35091 DAR ES SALAAM** (humu ndani akirejewa kama "Mkazi") hakimiliki ya kimila (itaitwa "hakimiliki") juu ya ardhi iliyofafanuliwa katika **Jedwali** (humu ndani itaitwa "ardhi") kwa kipindi kisicho na **Kikomo** tangu tarehe ......15th...... mwezi DESEMBER mwaka **2023** kwa maudhui na tafsiri halisi ya Sheria ya Ardhi ya Vijiji na kwa kuzingatia vipengele vyake na kanuni zozote zinazotungwa chini ya sheria hiyo au sheria mbadala au marekebisho yake na kwa majibu wa masharti yafuatayo:

i) Mkazi atalipa kodi ya mwaka ya Sha.10,060/- kabla ya tarehe..01....ya mwezi...07.....kila mwaka (kama inahusika).
ii) Ardhi itatumika kwa ajili ya **viwanda.**
iii) Mkazi atawajibika kuhifadhi mazingira (ardhi na maji)
iv) Mkazi atahakikisha kwamba mipaka ya ardhi inalindwa na kutunzwa na idumu kuwa bayana kwa kipindi chote cha hakimiliki.
v) Mkaziataheshimu na kuhifadhi haki za njia zilizopo.
vi) Uhakilishi wa hakimiliki kwa mtu yeyote au kikundi chochote cha watu ambao kwa kawaida si wakazi wa kijiji lazima uidhinishwe na Halmashauri ya Kijiji.

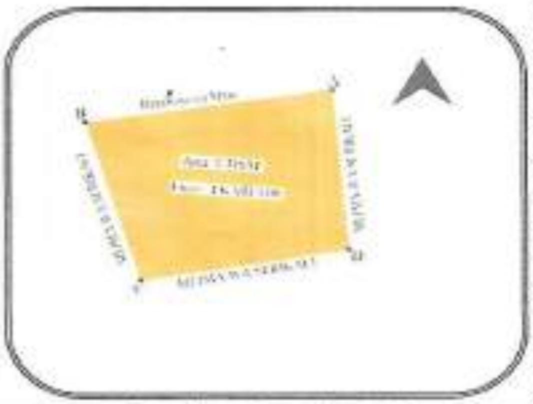
JEDWALI
(Maelezo kamili ya eneo na mipaka yake)

Ardhi hii yenye eneo lenye ukubwa wa ekari **8.0** iko katika Kitongoji cha Bumva No. 1 (B), Kijiji cha Bumva.

A	440010	9609991
B	439801	9609958
C	439847	9609795
D	440023	9609826

Kaskazini inapakana na barabara ya Mtaa.
Kusini inapakana na Mlima wa Serikali.
Mashariki inapakana na Mlima wa Serikali.
Magharibi inapakana na Mlima wa Serikali.

Kama inavyooneshwa katika mchoro/ramani hapa kulia.



1.Jina kamili: **MATESIE MALIMA MLINDA.**

Saini..

Anuani S. L. P. 16 KAHAMA, SHINYANGA.

Wadhifa: Mwenyekiti wa Kijiji

LAKIRI/MHULI WA HALMASHAURI YA KIJIJI

2. Jina kamili: **DAMAS THOMAS NGEREJA.**

Saini..

Anuani :S. L. P.16, KAHAMA, SHINYANGA

Wadhifa: **Afisa Mtendaji wa Kijiji**

3.Mmiliki(Mkazi)

Jina	Saini/ dole gumba	LAKIRI
i. **CHUO KIKUU CHA DAR ES SALAAM**..................		

PROF. WILLIAM A.L. ANANGISYE
MAKAMU MKUU WA CHUO

PROF. SAUDIN J. MWAKAJE
MWANASHERIA MKUU WA
CHUO NA KATIBU WA BARAZA

LAKIRI

3.Imegongwa Lakiri ya Halmashauri ya Wilaya ya Msalala na kusainiwa leo

Tarehe...15th... Mwezi..DEC... Mwaka 2023.

Jina: **LAZARO FRANCIS NDENGA**

Saini:..

Wadhifa: **Afisa Ardhi Mteule wa Wilaya**

Appendix IX: Approval Letter & ToR

THE UNITED REPUBLIC OF TANZANIA

VICE PRESIDENT'S OFFICE
UNION AND ENVIRONMENT

NATIONAL ENVIRONMENT MANAGEMENT COUNCIL
(NEMC)

In reply please quote: **Ref. No.** HO.145/259/02/01 — Date: **27th October 2023**

University of Dar es Salaam,
P.O. Box 35052,
Dar es Salaam.

RE: REVIEW OF SCOPING REPORT AND APPROVAL OF TERMS OF REFERENCE FOR THE PROPOSED CONSTRUCTION AND OPERATION OF MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION

Kindly refer to the heading above.

2. We acknowledge the receipt of the Scoping Report and initial draft of the Terms of Reference (ToR) for the project referenced No. **EC/EIA/2023/7094**, both relate to conducting Environmental and Social Impact Assessment (ESIA) for the project mentioned.

3. After a thorough review of the submitted documents, the Council found that the Terms of Referance (ToR) highlighted are generally acceptable to guide the EIA study and hence are now **approved.** Prepare and submit the EIA report for review. The submitted report should adhere to regulations of the EIA and Audit Regulations of 2005 as amended in 2018, particularly on PART X.

4. However, it is essential to align with the following accounts:

i. Evidence of land ownership that bears the name of the developer for the surveyed area with a land use plan that is compatible with the proposed activity should be appended.

ii. You must consult all relevant stakeholders (which should include but not be limited to **Residence Mines Office of Kahama, OSHA, LTBWB, FIRE AND RESCUE FORCE, and LGAs**) and there should be evidence that they have been consulted by signing against their names; In addition, their concern must be taken on board in this study;

Lake Victoria West Zone Office, Geita Office
Website: www.nemc.or.tz

iii. Attach readable site layout plan and approved architectural drawings showing the location of all project components indicating plot ratio, coverage and setbacks;

iv. Be certain to present a thorough and informative project design that includes all of its components;

v. Ensure that baseline information/data on water quality, air quality, noise level and vibration, wind speed and direction as well as flora and fauna are captured well in the report and should be based on recent data;

vi. Identify all project-related waste, and ensure proper handling and disposal procedures are in place for solid, liquid, and hazardous waste;

vii. Submit the conceptual design of the Tailing Storage Facility (TSF) approved by the Ministry of Water (Dam Safety Department);

viii. Exhaustively cover concerns regarding the handling of unused carbon and empty chemical containers in the EIS;

ix. Efficiently identify and exhaustively document all project-associated impacts, ensuring that robust mitigation measures are properly incorporated into the Environmental Management Plan (EMP);

x. Ensure you engage a knowledgeable individual in the mining field, preferably a Metallurgy and Mineral Processing Engineer, for your study;

xi. Please provide a thorough breakdown of the tasks and procedures planned for the project's construction, operational, and decommissioning phases;

xii. The report should provide an extensive assessment of the project's compliance with pertinent Acts, Policies, Regulations, and Legislation;

xiii. Ensure that copies of relevant permits and licences from relevant authorities related to your activities are included in the improved EIS. The certificates/permits/licenses should bear the name of the developer or state the relationship with the developer; These include but are not limited to (Mineral Rights documents and Land ownership/contract documents etc);

xiv. Emergency Preparedness and Response Plan to be presented as a standalone chapter;

xv. Please provide a detailed description of the management of absolute chemicals and procedures for handling chemical spills;

xvi. Offer a detailed description of the stormwater management;

xvii. Append the approval letter for the Terms of Reference (ToR), and please ensure the submission of five copies of the Environmental and Social Impact Assessment (ESIA) report to NEMC for review.

Upon submission of the ESIA report and payment of review charges, as stipulated by the system, the Council will arrange for site verification and technical review meetings to verify the adequacy of the presented EIS. Please be mindful that the review charges do not encompass the transportation costs for three officers who will be visiting the project site for verification. It is important to note that these transport expenses are the responsibility of the project proponent.

Should you need additional information or clarification on this matter, please, contact us through Tel. No. **+255 685 117 589**.

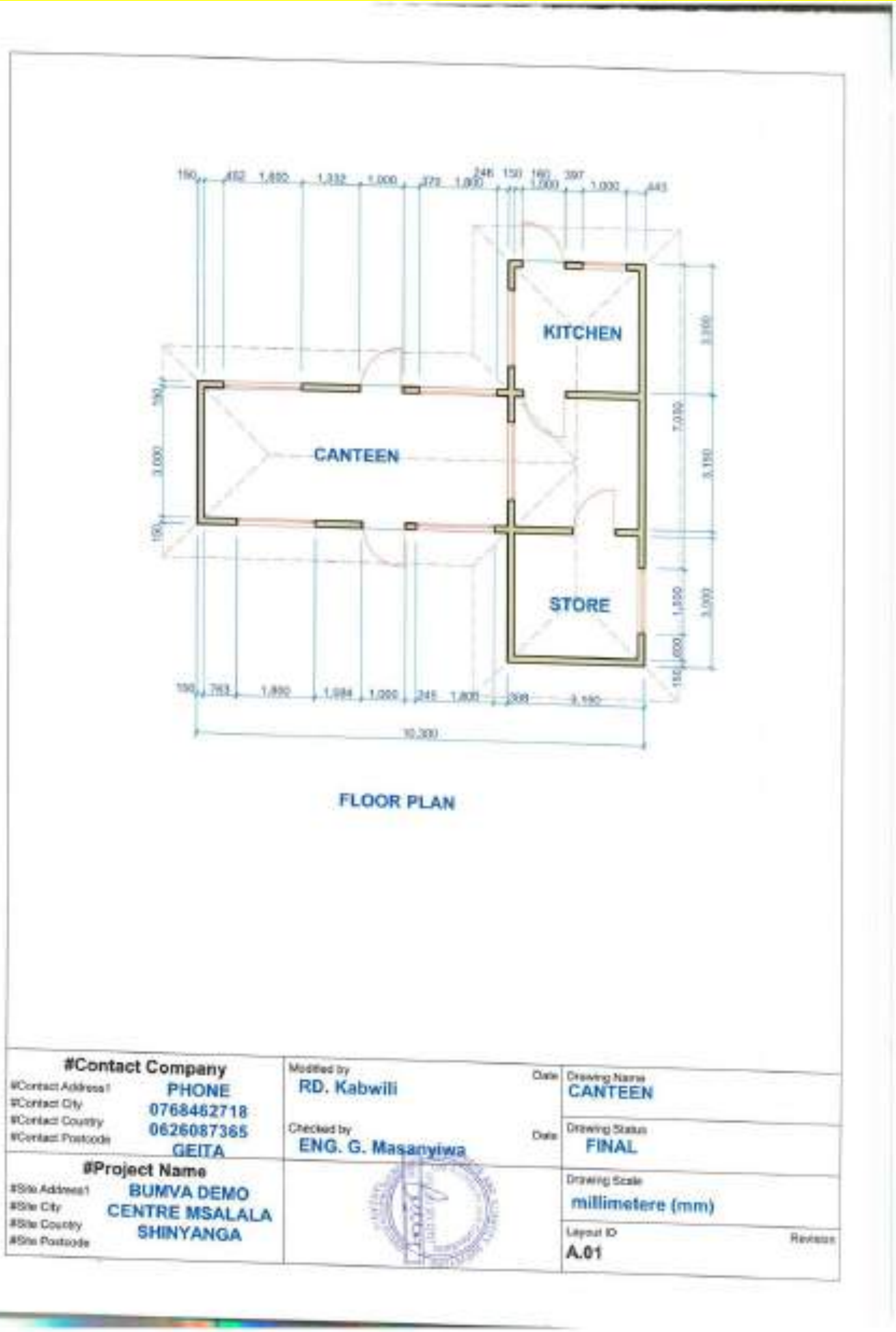
Yours sincerely,

Eng. Dr. Betina Igulu

Ag. Zonal Manager

Copy to: School of Mines and Geosciences,
University of Dar es Salaam,
P.O. Box 35052,
Dar es Salaam.

Appendix X: Architectural Drawings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STORE
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0626087365
GEITA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
CANTEEN
Drawing Status
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#Project Name
#Site Address1
#Site City
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BUMVA DEMO
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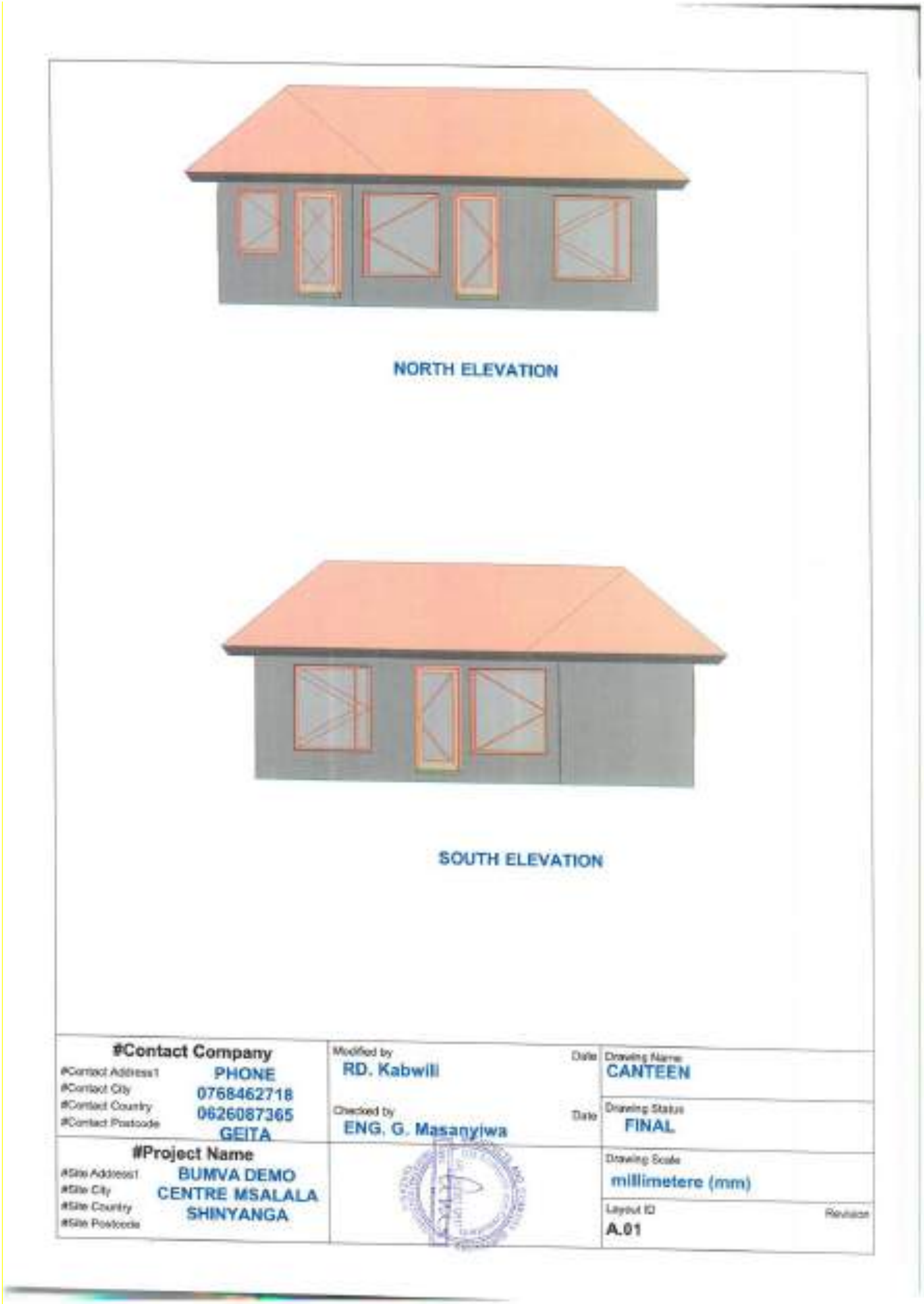
SHINYANGA
Drawing Scale
millimetere (mm)
Layout ID
A.01
Revision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#Site City
CENTRE MSALALA
#Site Country
SHINYANGA
#Site Postcode
Modified by
RD. Kabwili
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
CANTEEN
Date
Drawing Status
FINAL
Drawing Scale
millimetere (mm)
Layout ID
A.01
Revision

EAST ELEVATION

WEST ELEVATION

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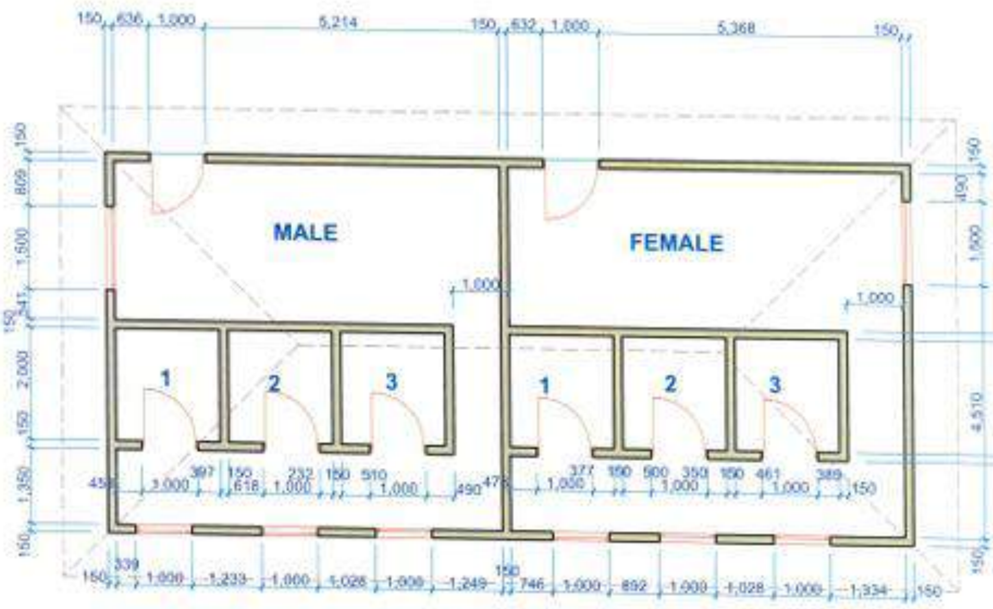
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode		Drawing Scale millimetere (mm) Layout ID A.01 Revision



FLOOR PLAN

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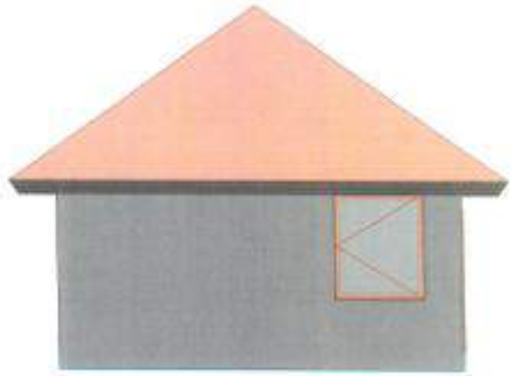
	Checked by **ENG. G. Masanyiwa**	Date	Drawing Status **FINAL**
#Project Name #Site Address1 **BUMVA DEMO** #Site City **CENTRE MSALALA** #Site Country **SHINYANGA** #Site Postcode			Drawing Scale **millimeter(mm)**
			Layout ID **A.01** Revision



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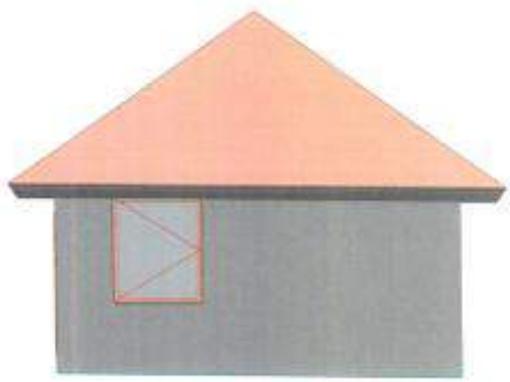

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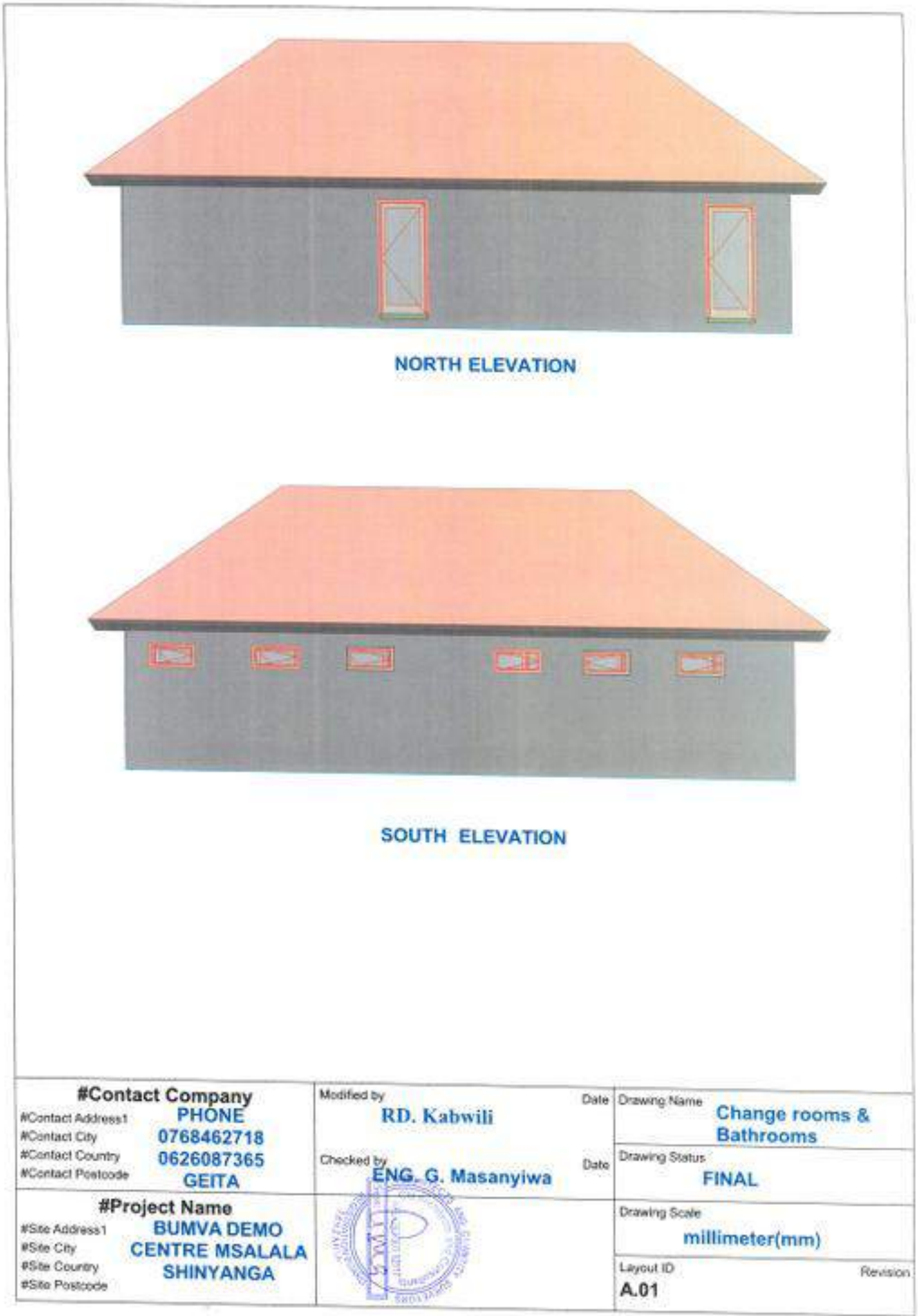
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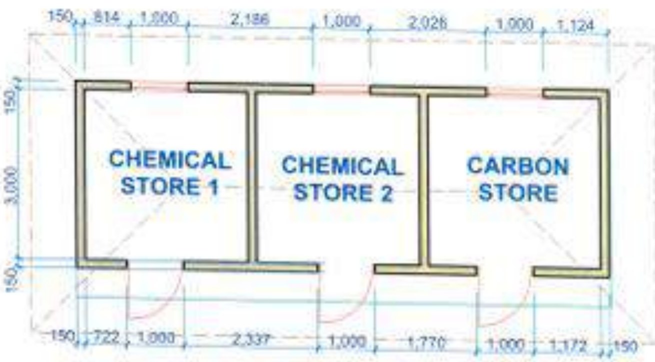
#Contact City
#Contact Country
#Contact Postcode
PHONE
0768462718
0626087365
GEITA
#Project Name
#Site Address1
#Site City
#Site Country
#Site Postcode
BUMVA DEMO
CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
Change rooms &
Bathrooms
Drawing Status
FINAL
Drawing Scale
millimeter(mm)
Layout ID
A.01
Revision



FLOOR PLAN

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	Checked by **ENG. G. Masanyiwa**	Date	Drawing Status **FINAL**
#Project Name #Site Address1 / #Site City / #Site Country / #Site Postcode **BUMVA DEMO CENTRE MSALALA SHINYANGA**			Drawing Scale **millimeter (mm)**
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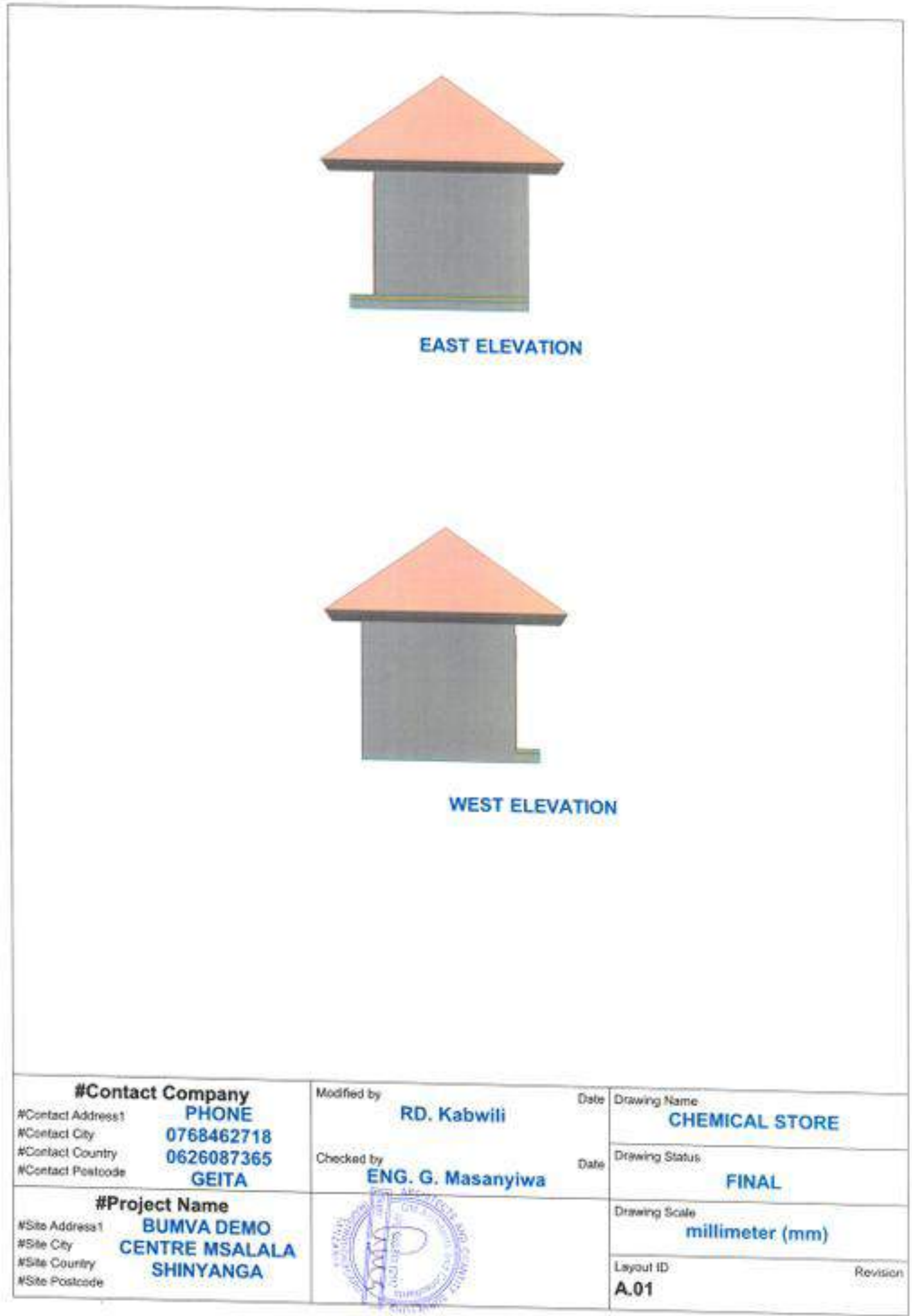
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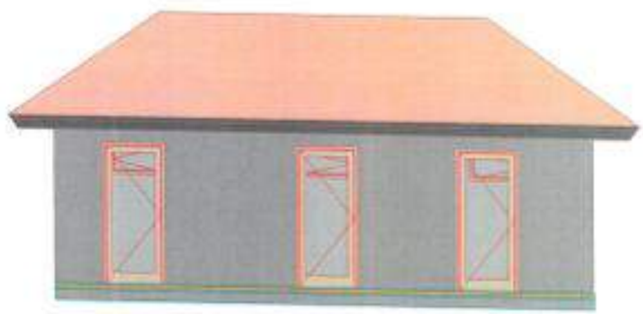
BUMVA DEMO
CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
CHEMICAL STORE
Drawing Status
FINAL
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision

NORTH ELEVATION



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	Checked by: ENG. G. Masanyiwa (Date)	Drawing Status: FINAL
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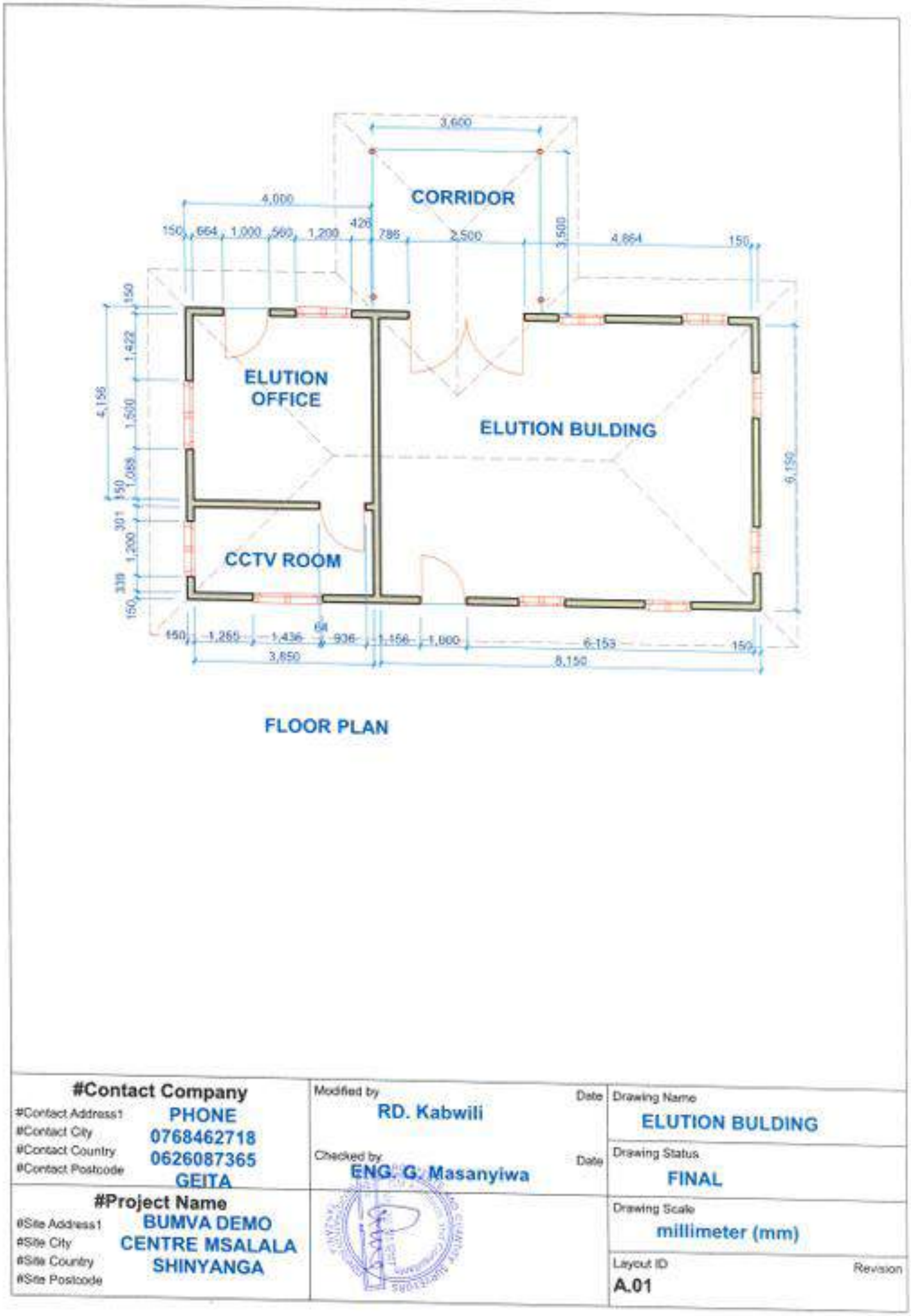
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PHONE
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0626087365
GEITA
#Project Name
#Site Address1
#Site City
#Site Country
#Site Postcode
BUMVA DEMO CENTRE MSALALA SHINYANGA
Modified by
RD. Kabwili
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
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Drawing Status
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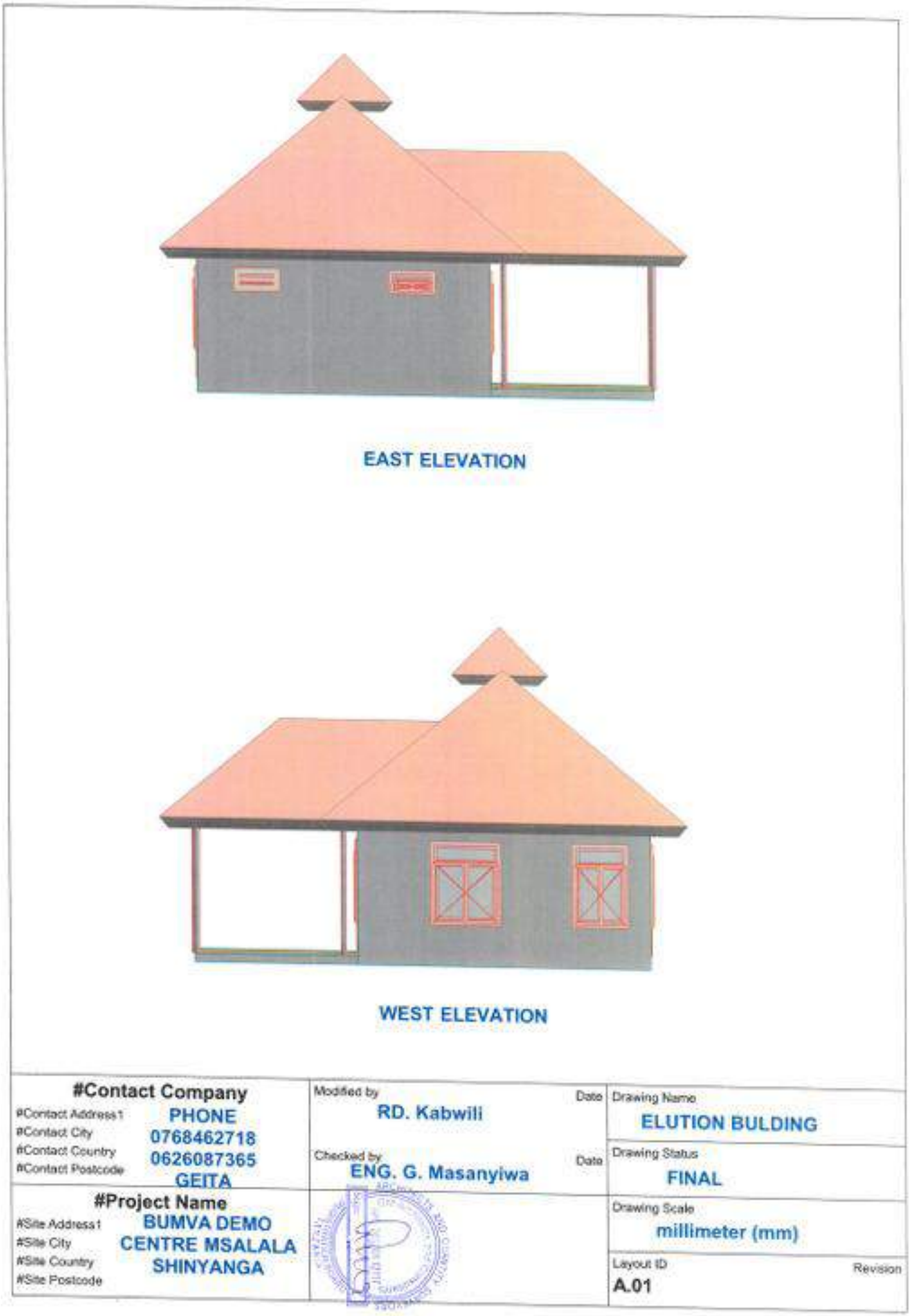
Layout ID
A.01
Revision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#Contact Country
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0626087365
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#Project Name
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#Site Postcode
BUMVA DEMO
CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
ELUTION BULDING
Drawing Status
FINAL
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision


NORTH ELEVATION
SOUTH ELEVATION
#Contact Company
#Contact Address1
#Contact City
#Contact Country
#Contact Postcode
PHONE
0768462718
0626087365
GEITA
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#Site City
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CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
ELUTION BULDING
Drawing Status
FINAL
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision

CHEMICAL STORE 2
CHEMICAL STORE 1
CARBON STORE
RESTING ROOM
TOILET
BLASTING CHAMBER
SMELTING CHAMBER
WAITING SHED
CCTV ROOM
OFFICE
ELUTION BULDING
CORRIDOR FROM LAB
FLOOR PLAN
FINAL
A.01.1


NORTH ELEVATION
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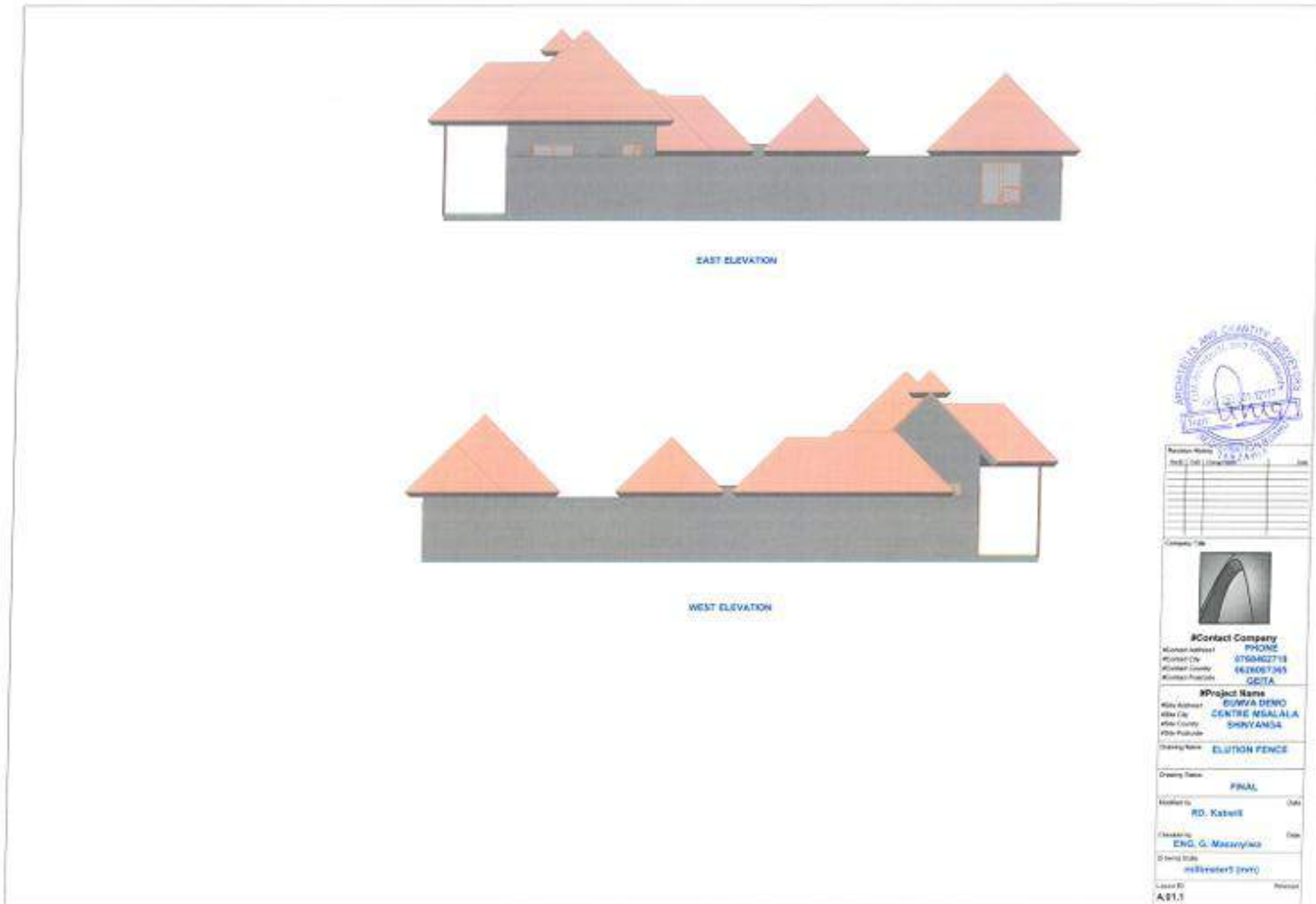
RD. Kabwili
ENG. G. Masanyiwa
millimeter(s) (mm)
A.01.1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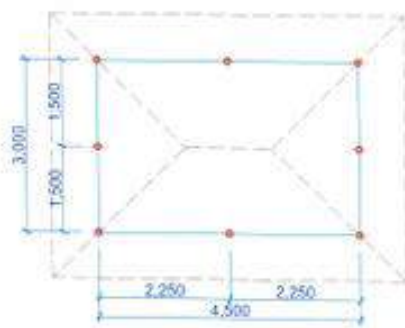

FLOOR PLAN

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#Project Name #Site Address1 #Site City #Site Country #Site Postcode BUMVA DEMO CENTRE MSALALA SHINYANGA		Drawing Scale: millimeter (mm) Layout ID: A.01 Revision

EAST ELEVATION

WEST ELEVATION

#Contact Company #Contact Address1 PHONE #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by RD. Kabwili	Date	Drawing Name Standby Generator shed
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#Project Name #Site Address1 #Site City #Site Country #Site Postcode BUMVA DEMO CENTRE MSALALA SHINYANGA			Drawing Scale millimeter (mm)
			Layout ID A.01 Revision

NORTH ELEVATION

SOUTH ELEVATION

#Contact Company #Contact Address1 / #Contact City / #Contact Country / #Contact Postcode PHONE 0768462718 0626087365 GEITA	Modified by RD. Kabwili Checked by ENG. G.Masanyiwa	Date Date	Drawing Name Standby Generator shed Drawing Status FINAL
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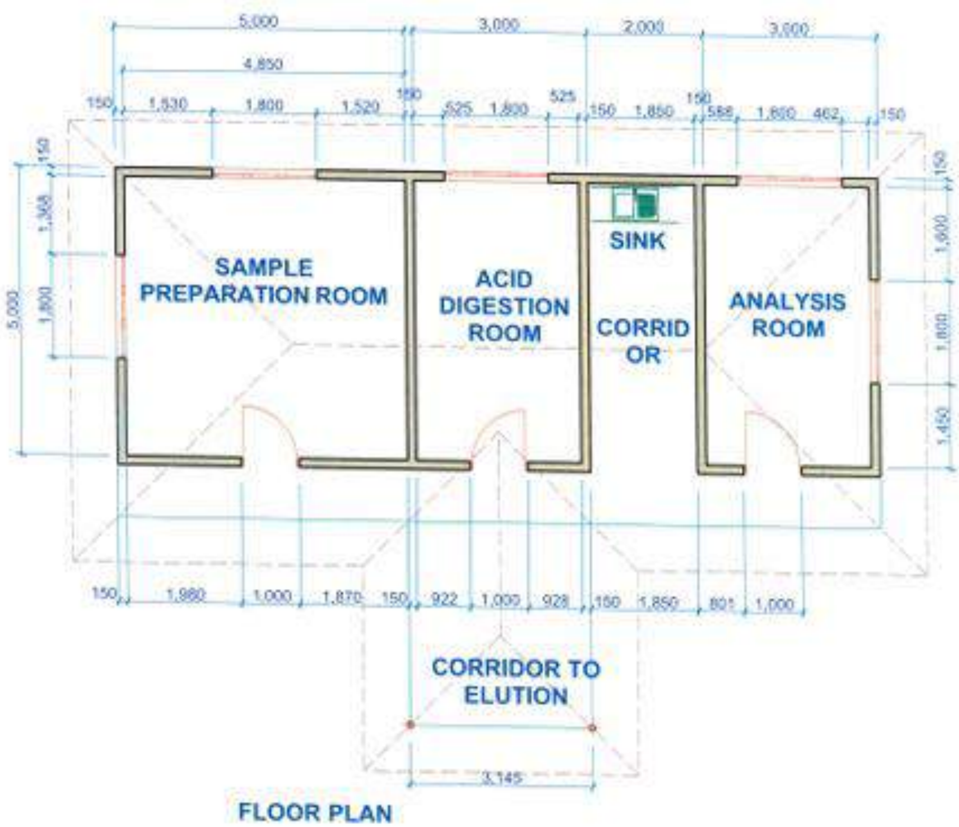

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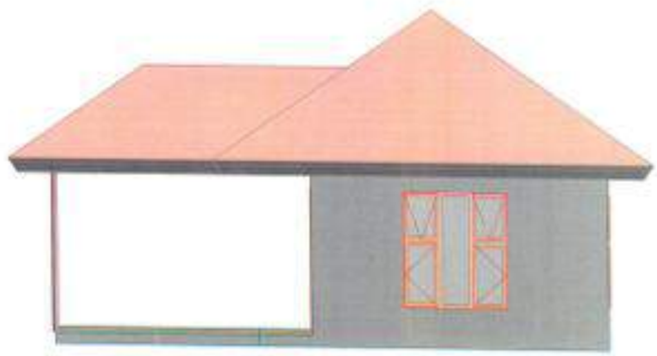

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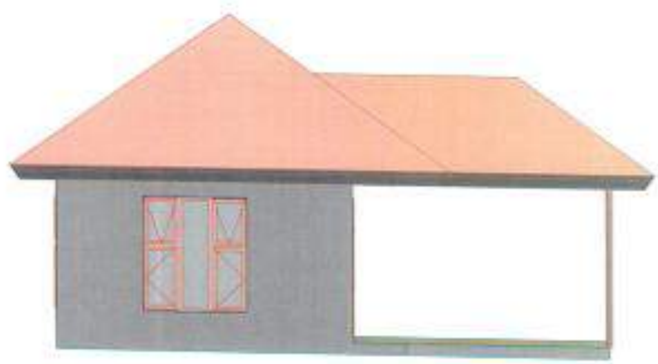

WEST ELEVATION

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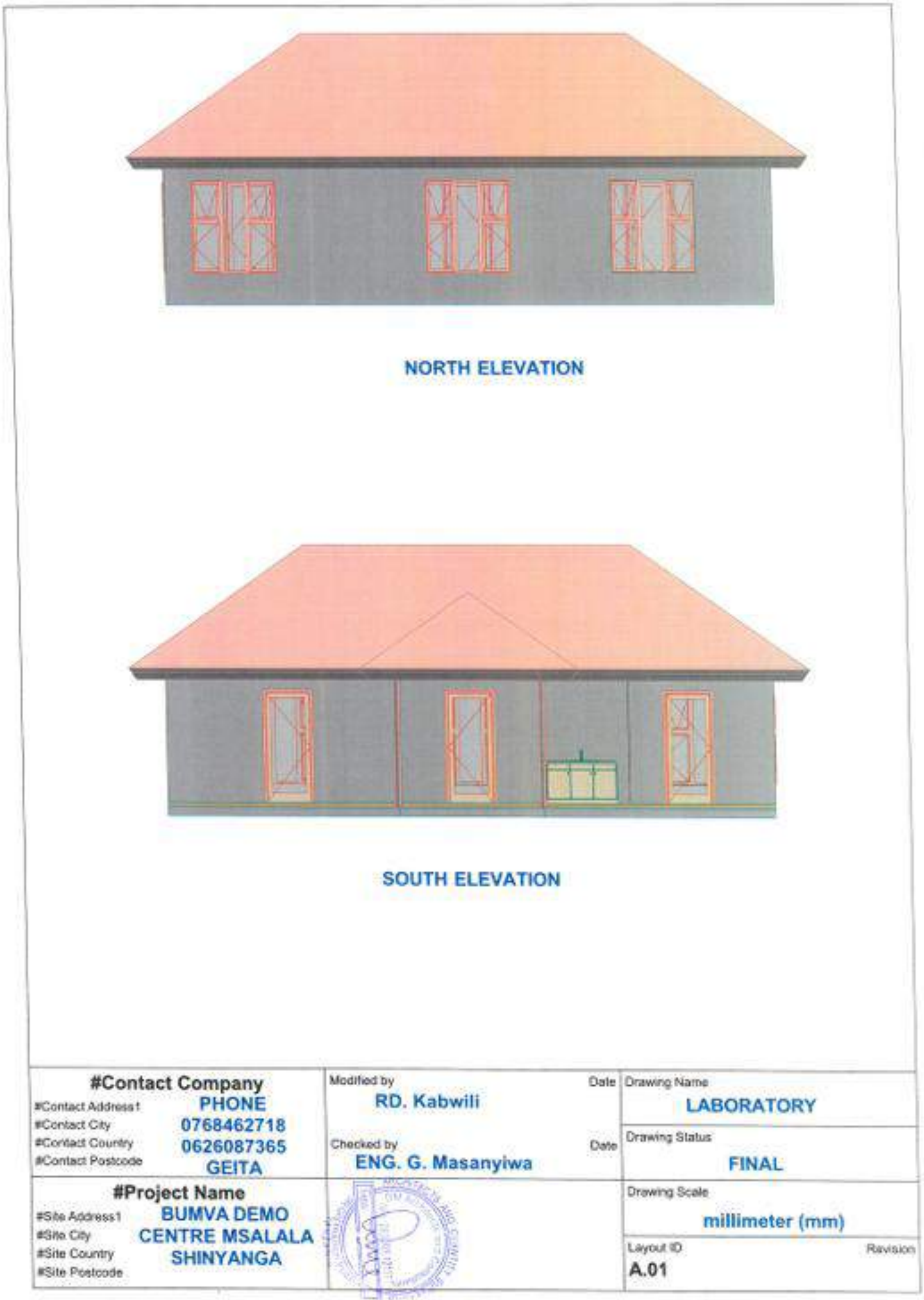
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SOUTH ELEVATION
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#Contact Country
#Contact Postcode
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0626087365
GEITA
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#Site City
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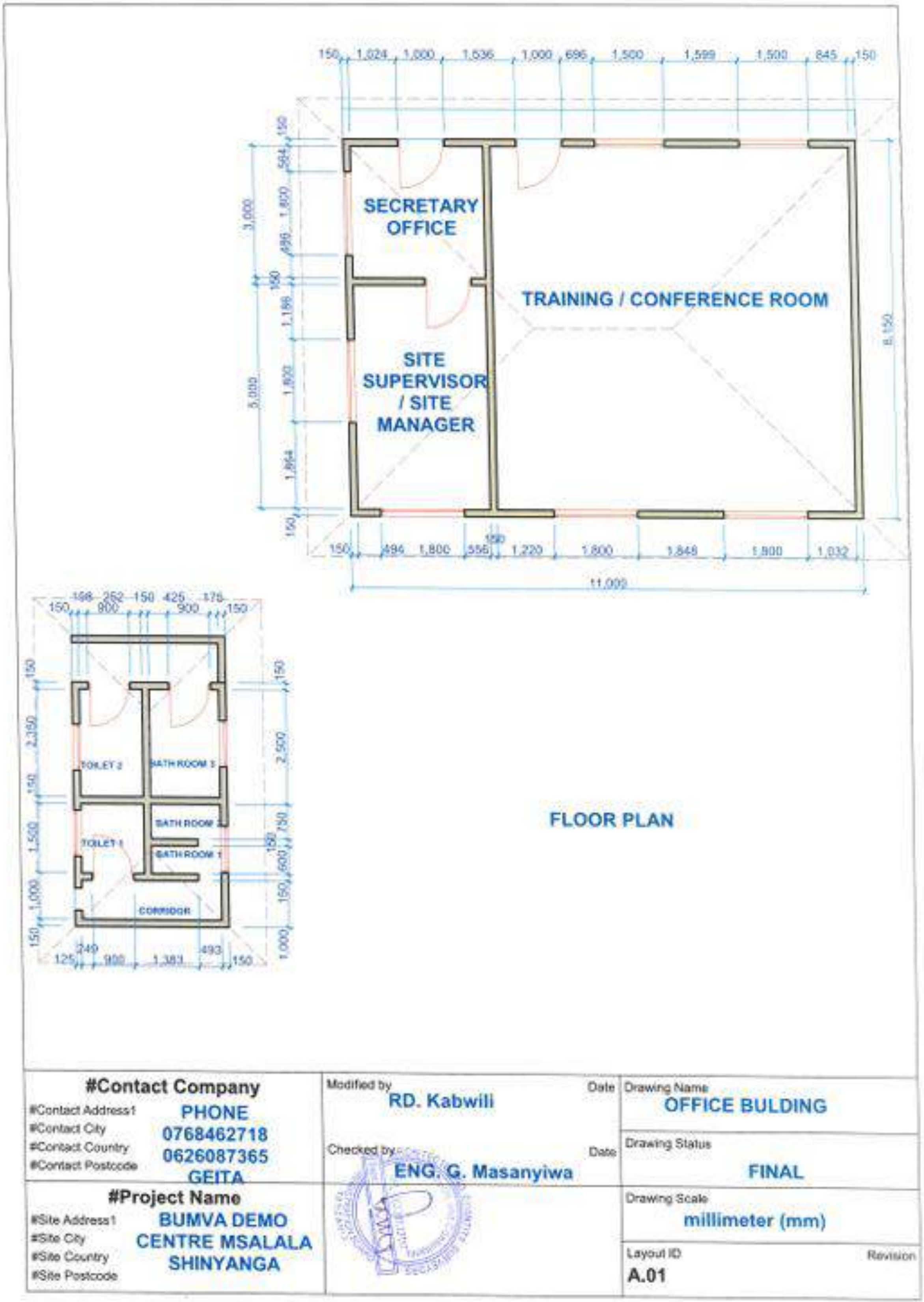
#Site Postcode
BUMVA DEMO
CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
LABORATORY
Drawing Status
FINAL
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision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TRAINING / CONFERENCE ROOM
SITE SUPERVISOR / SITE MANAGER
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BATH ROOM 3
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BATH ROOM 1
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FLOOR PLAN
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#Contact City
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PHONE
0768462718
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GEITA
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BUMVA DEMO CENTRE MSALALA SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
OFFICE BULDING
Drawing Status
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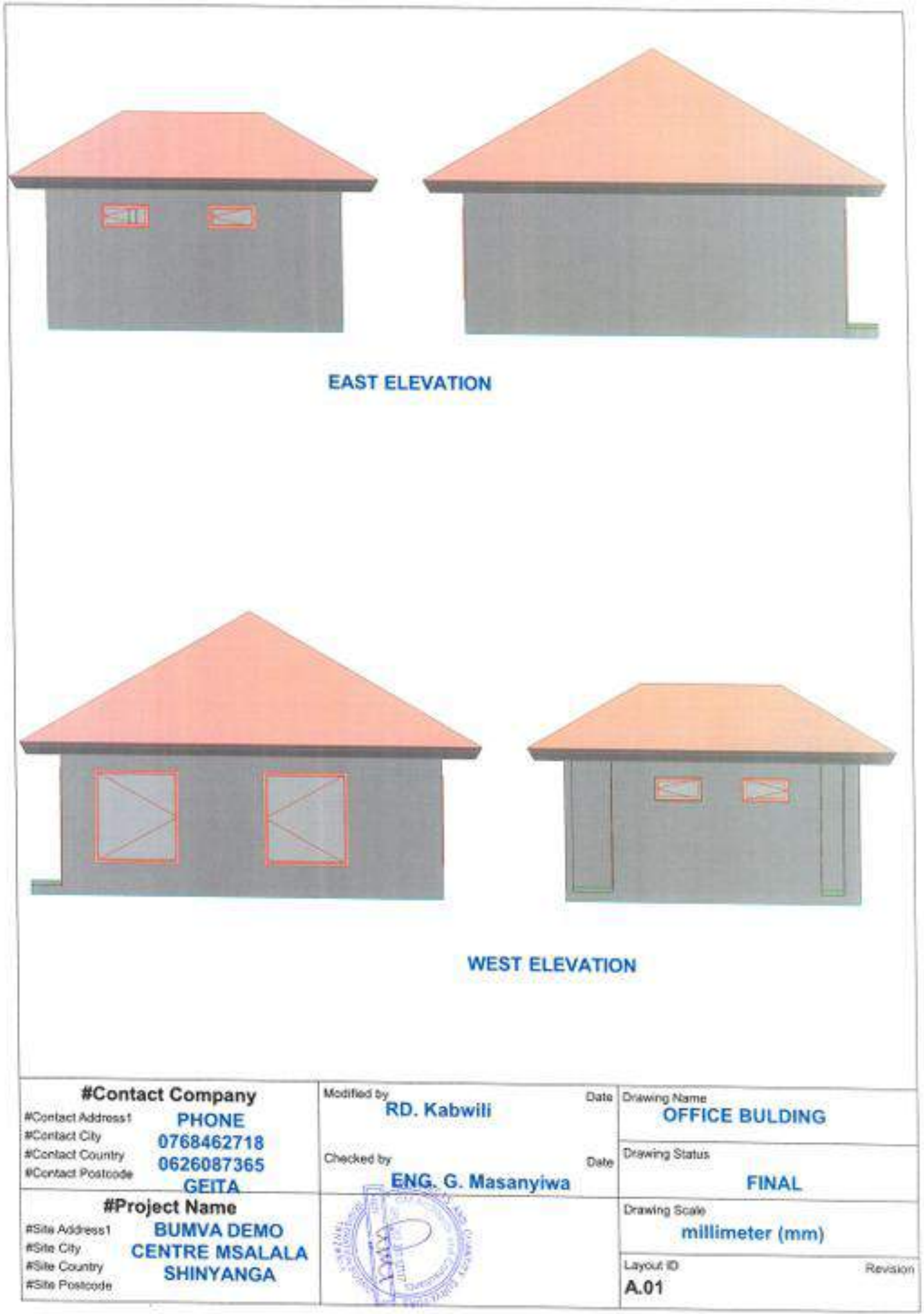
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision



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GEITA
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BUMVA DEMO
CENTRE MSALALA
SHINYANGA
Modified by
RD. Kabwili
Date
Checked by
ENG. G. Masanyiwa
Date
Drawing Name
OFFICE BULDING
Drawing Status
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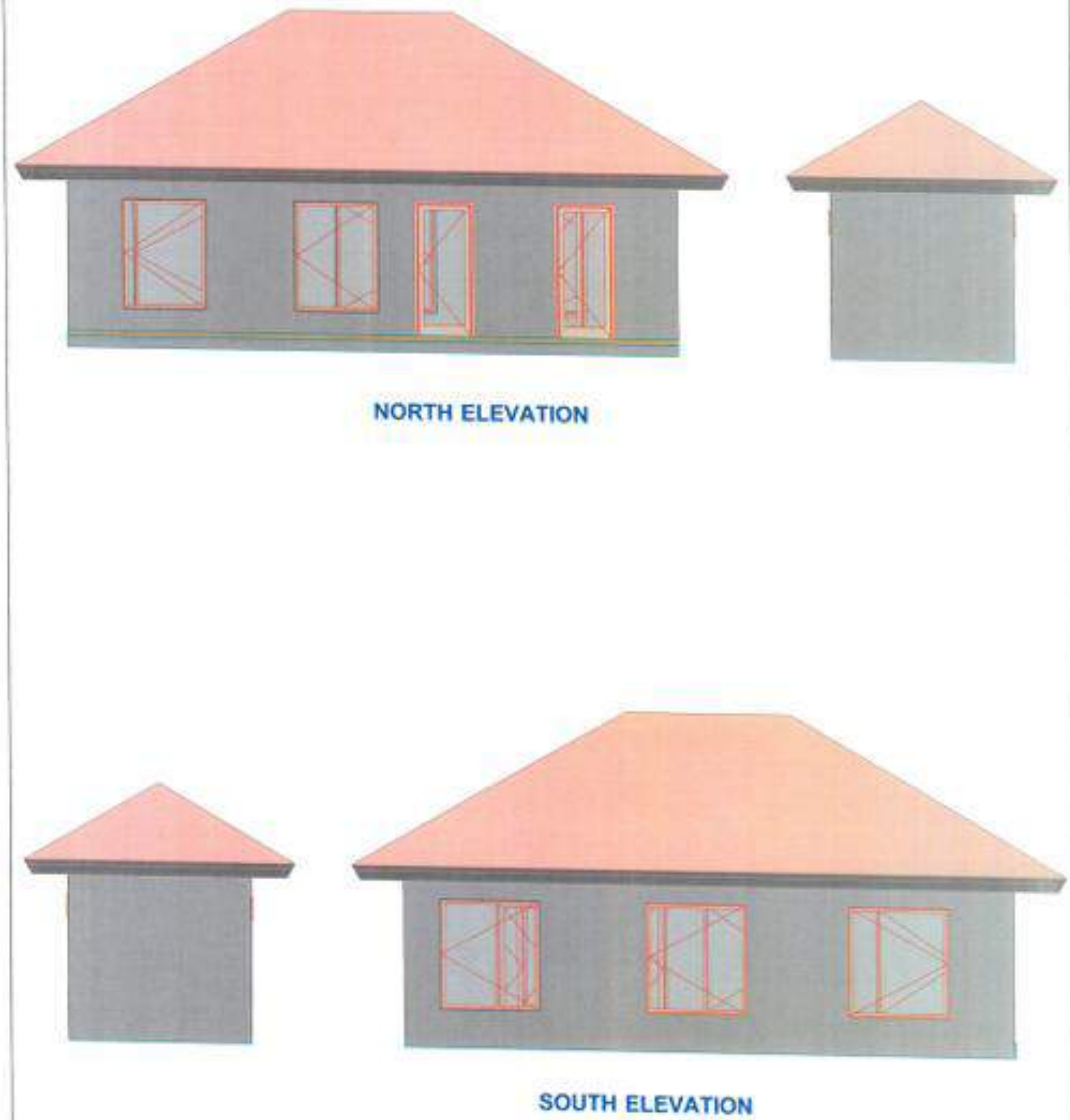
Drawing Scale
millimeter (mm)
Layout ID
A.01
Revision



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#Project Name
#Site Address1 BUMVA DEMO
#Site City CENTRE MSALALA
#Site Country SHINYANGA
#Site Postcode

Modified by RD. Kabwili Date
Checked by ENG. G. Masanyiwa Date

Drawing Name: OFFICE BULDING
Drawing Status: FINAL
Drawing Scale: millimeter (mm)
Layout ID: A.01 Revision

FLOOR PLAN

#Contact Company #Contact Address1 #Contact City #Contact Country #Contact Postcode **PHONE** **0768462718** **0626087365**	Modified by **RD. Kabwili**	Date	Drawing Name **Plant Office**
	Checked by **ENG. G. masanyiwa**	Date	Drawing Status **FINAL**
#Project Name #Site Address1 #Site City #Site Country #Site Postcode **BUMVA DEMO** **CENTRE MSALALA** **SHINYANGA**			Drawing Scale **millimeter (mm)**
			Layout ID **A.01** Revision

EAST ELEVATION

WEST ELEVATION

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	Checked by ENG. G. masanyiwa Date	Drawing Status FINAL
#Project Name #Site Address1 #Site City #Site Country #Site Postcode BUMVA DEMO CENTRE MSALALA SHINYANGA		Drawing Scale millimeter (mm)
		Layout ID A.01 Revision

NORTH ELEVATION

SOUTH ELEVATION

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	Checked by ENG. G. masanyiwa Date	Drawing Status FINAL
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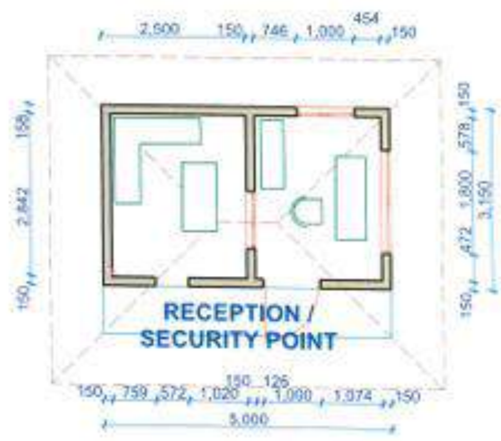
		Layout ID A.01 Revision



FLOOR PLAN

#Contact Company #Contact Address1 #Contact City #Contact Country #Contact Postcode	**PHONE 0768462718 0626087365 GEITA**	Modified by **RD. Kabwili**	Date	Drawing Name **RECEPTION / SECURITY POINT**
		Checked by **ENG. G. Masanyiwa**	Date	Drawing Status **FINAL**
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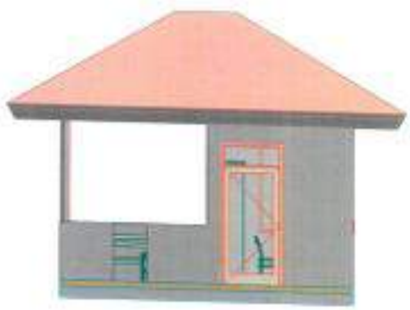
				Layout ID **A.01** Revision

EAST ELEVATION

WEST ELEVATION

#Contact Company #Contact Address1 PHONE #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by RD. Kabwili Checked by ENG. G. Masanyiwa	Date Date	Drawing Name RECEPTION / SECURITY POINT Drawing Status FINAL
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode			Drawing Scale millimeter (mm) Layout ID A.01 Revision

NORTH ELEVATION



SOUTH ELEVATION

#Contact Company #Contact Address1 PHONE #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by RD. Kabwili — Date Checked by ENG. G. Masanyiwa — Date	Drawing Name RECEPTION / SECURITY POINT Drawing Status FINAL
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode		Drawing Scale millimeter (mm) Layout ID A.01 — Revision

FLOOPLAN

#Contact Company #Contact Address1 **PHONE** #Contact City **0768462718** #Contact Country **0626087365** #Contact Postcode **GEITA**	Modified by **RD. Kabwili** Date Checked by **ENG. G. Masanyiwa** Date	Drawing Name **TOILET** Drawing Status **FINAL**
#Project Name #Site Address1 **BUMVA DEMO** #Site City **CENTRE MSALALA** #Site Country **SHINYANGA** #Site Postcode		Drawing Scale **millimeter (mm)** Layout ID **A.01** Revision

EAST ELEVATION

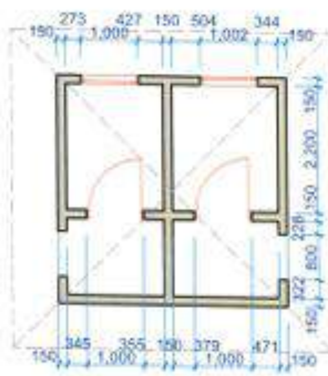
WEST ELEVATION

#Contact Company #Contact Address1 PHONE #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by RD. Kabwili Date Checked by ENG. G. Masanyiwa Date	Drawing Name TOILET Drawing Status FINAL
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode		Drawing Scale millimeter (mm) Layout ID A.01 Revision

NORTH ELEVATION

SOUTH ELEVATION

#Contact Company #Contact Address1 PHONE #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by RD. Kabwili — Date Checked by ENG. G. Masanyiwa — Date	Drawing Name TOILET Drawing Status FINAL
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode		Drawing Scale millimeter (mm) Layout ID A.01 — Revision



FLOOR PLAN

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			Layout ID A.01 Revision

EAST ELEVATION

WEST ELEVATION

#Contact Company PHONE #Contact Address1 #Contact City 0768462718 #Contact Country 0626087365 #Contact Postcode GEITA	Modified by **RD. Kabwili** Date Checked by **ENG. G. Masanyiwa** Date	Drawing Name **TOILET** Drawing Status **FINAL**
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NORTH ELEVATION

SOUTH ELEVATION

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	Checked by ENG. G. Masanyiwa	Date	Drawing Status FINAL
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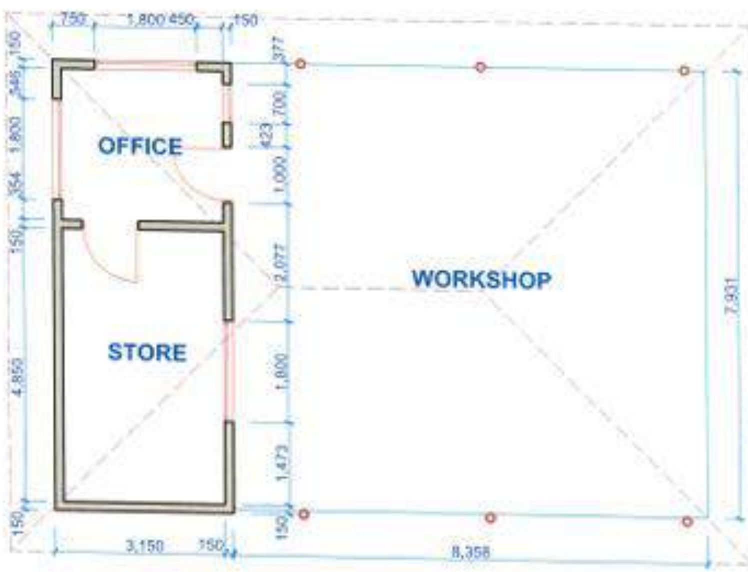
			Layout ID A.01 Revision



FLOOR PLAN

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	Checked by ENG. G. Masanyiwa — Date	Drawing Status: FINAL
#Project Name #Site Address1 BUMVA DEMO #Site City CENTRE MSALALA #Site Country SHINYANGA #Site Postcode		Drawing Scale: millimeter (mm)
		Layout ID: A.01 — Revision


EAST ELEVATION
WEST ELEVATION
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CENTRE MSALALA
SHINYANGA
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RD. Kabwili
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ENG. G. Masanyiwa
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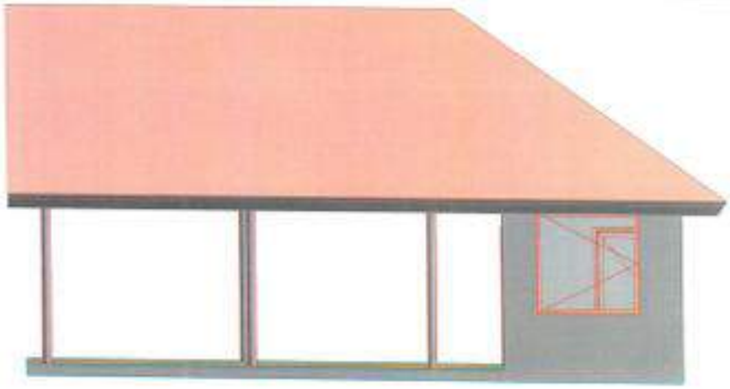
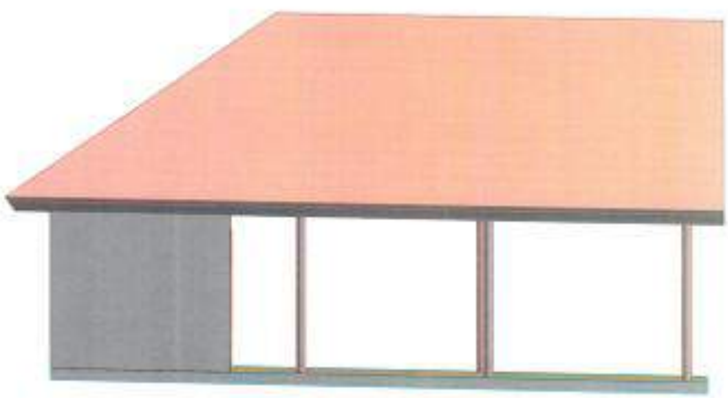


NORTH ELEVATION



SOUTH ELEVATION

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#Contact City 0768462718
#Contact Country 0626087365
#Contact Postcode GEITA

#Project Name
#Site Address1 BUMVA DEMO
#Site City CENTRE MSALALA
#Site Country SHINYANGA
#Site Postcode

Modified by RD. Kabwili
Date

Checked by ENG. G. Masanyiwa
Date

Drawing Name WORKSHOP
Drawing Status FINAL
Drawing Scale millimeter (mm)
Layout ID A.01
Revision

Appendix XI: Detailed Design

THE UNITED REPUBLIC OF TANZANIA

PROPOSED CONSTRUCTION AND OPERATION OF THE CIP PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION

PROPOSED DESIGN AND CONSTRUCTION OF TAILINGS STORAGE FACILITY

FINAL REPORT

DETAILED DESIGN

Submitted by

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20th April 2024

Executive summary

The Government of the United Republic of Tanzania (URT) has received funds from the World Bank (WB) Global Environmental Facility (GEF) to undertake The Environmental Health and Pollution Management Project (EHPMP). The EHPMP is five years (July 2020–July 2025) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana which aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries.

In response, the URT government, through EHPMP intends to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region for which it has mandated University of Dar es salaam to develop a Carbon In Pulp (CIP) Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region.

In partial completion of detailed design for the proposed TSF and civil engineering infrastructures on the land sub-section and in the partial fulfilment of the documentation necessary for application of relevant building permits, the client engaged the hereby reported detailed design of the Tailings Storage Facility (TSF) at the proposed project site.

The objective of the detailed design is to present the analysis of the environmental, site condition and the investigations taken. This analysis involves the civil engineering properties of the grounds at the project site such that the ground stability / bearing capacity, seepage flow analysis and control, construction method, slope stability analysis and detailed parameters of the Tailings Storage Facility (TSF). It outlines the basis of the design and justifies the parameters adopted for the engineering design, construction, operation, rehabilitation and after closure of the Tailings Storage Facility.

Tailings Storage Facility design comprises of dam classification, analyzing the stability of the ground and critical sections comparing to the bearing capacity obtained from laboratory tests of samples from Geotechnical investigations done, seepage analysis so as to reduce impacts to the environment, provide a safe construction method, the parameters for the Tailings reservoir to accommodate the Tailings, the information from the other gold processing plants about the particle distribution of the Tailings aided in the design of decant tower, also the report provides the preliminary stability analysis of raising the embankment dam three times using downward construction methods every after 5 years, results indicate that the embankment wall will be stable over a 20-year design life and finally the report ends with foundations considerations, conclusions and recommendations.

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Acronyms and abbreviations

AMD	-	Acid Mine Drainage
a.m.s.l	-	above mean sea level
ASGM	-	Artisanal Small Scale Gold Miners
CIP	-	Carbon In Pulp
EHPMP	-	Environmental Health and Pollution Management Project
FoS	-	Factor of Safety
GEF	-	Global Environmental Facility
GMW	-	Groundwater monitoring wells
GST	-	Geological Survey of Tanzania
HDPE	-	High Density Polyethylene
IDF	-	Inflow Design Flood
MCE	-	Maximum Credible Earthquake
MDD		Maximum Dry Density
MoM	-	Ministry of Minerals
MoW	-	Ministry of Water
MSM	-	Movement Survey Monuments
NEMC	-	National Environment Management Council
NMD	-	Neutral Metalliferous Drainage
OMC		Optimum Moisture Content
RWP	-	Return Water Pond
SWD	-	Site Surface Water Drainage
SWI	-	Surface Water Impoundments
TSF	-	Tailing Storage Facility
UDSM	-	University of Dar es Salaam
URT	-	United Republic of Tanzania
UTM	-	Universal Transverse Mercator
VWP	-	Vibrating Wire Piezometer
WB	-	World Bank
WGS	-	The World Geodetic System

1.0 Chapter ONE: INTRODUCTION

1.1 Description of the Project and Tailings Storage Facility (TSF)

The Government of the United Republic of Tanzania (URT) has received funds from the World Bank (WB) Global Environmental Facility (GEF) to undertake The Environmental Health and Pollution Management Project (EHPMP). The EHPMP is five years (July 2020–July 2025) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana which aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries. ASGM uses mercury in gold recovery in a manner that is dangerous to human health and the environment because amalgamation is done with bare hands and the amalgam is heated in open air to drive away the mercury. Furthermore, in ASGM for every 1 kg of gold recovered, about 2 kg of mercury is used and most of it is released into the environment. In response, the URT government, through EHPMP intends to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region for which it has mandated University of Dar es salaam (UDSM) to develop a Carbon In Pulp (CIP) Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region. Among the structures planned at the centre is a Tailings Storage Facility (TSF) (Figure 1, Appendix I - Figure 11 and Figure 12) that will allow for safe, optimum and sustainable handling of all tailings from the gold processing.

To allow for detailed design of the proposed TSF and foundations for other related civil engineering infrastructures at the site and in partial fulfilment of the documentation necessary for application of relevant building permits, the client engaged the hereby reported TSF engineering design services at the proposed project site.

1.2 Legal Requirements Guidelines and Supporting Principles

TSF design, construction, operation and closure is guided by several Tanzanian and international legislations, standard and guidelines. The TSF is designed based on the following legislations, standards and guidelines;

1.2.1 Legal Requirements

- The Mining (Safety Occupational Health and Environmental Protection) Regulations 2010
- The Water Resources Management (Dam Safety) Regulations 2013
- The Engineers Registration Act No. 15 of 1997 and its amendments and regulations
- The Environmental Management Act (No. 20) 2004 and Environmental Impact Assessment and Audit Regulations 2005

- The Forest Act (No. 14) 2002
- The National land use Planning Act (No. 6) 2007
- The Land Act (No. 4) 1999
- The Village Land Act (No. 5) 1999
- The Village planning and Regulation Act (No. 58) 2007
- The Local Government (District Authorities) Act CAP 287 R: E 2002
- The Local Government (Urban Authorities) Act CAP 288 R: E 2002
- The Investment Act (No. 26), 1997
- The Occupational Health and Safety Act (No. 4) 2003

1.2.2 Guidelines, Standard and Procedures

- The Tanzania Ministry of Water (Dam Safety Guidelines) 2020
- The Guideline to the preparation of a design report for tailings storage facilities (TSFs) by the Government of Western Australia, Department of Mines and Petroleum 2015
- Tailings Storage Facility consequence category Assessment (under ANCOLD 2012)
- Observational approach philosophy, identification of TSF Critical Operating Parameters and ongoing dam safety management
- Tailings geochemistry and management of Acid Mine Drainage (AMD) and neutral Metalliferous Drainage (NMD)
- ICOLD (1996) A guide to tailings dams and impoundments design, construction, use and rehabilitation (ICOLD Bulletin 106)
- Draft EPA / PIRSA Guideline Tailings and Tailings Storage Facilities EPA 2007
- The Tanzania Bureau of Standards Act (No 3) 1995

1.3 TSF Design Approach

In the lead up to selection of the preferred tailings storage option, the available leading practices of TSF design were analysed and also based on the available TSF footprint area and the site topography. Leading practices of TSF design require risk-based analysis to be applied. In this way a tailings management system can be developed which effectively manages potential safety, health, environmental and community impacts to acceptable levels to stakeholders and the authorities. The preferred option was then studied in more detail to ensure that the design would manage the identified risk issues, that geotechnical structural and risk management control designs are fit for purpose and that commitments made for construction, operation and closure of the TSF are practical, defendable and achievable. The TSF design selection methodology was based on the ranking system of key parameters including health, safety, environment, community and economic risk.

A TSF with storage capacity of 22,000 cubic metres is proposed as follows. The mine plant throughput is 20 tonnes per day. Assuming 95% availability of plant, it implies that the throughput per annum is equivalent to 20 tonnes per day x 95% x 365 days per year = 6,935 tonnes per year. Taking the solid density of ore to be 2.8 tonnes per meter cubic with 45% solids, we get the density of the slurry to be 1.41 tonnes per cubic meter from which a volume of 4,918 cubic meters per year is determined. Therefore, for a five-year design life before raising the TSF, an estimated reservoir volume of 22,132 cubic meters is required assuming only 10% of the water will be recycled. Starter dam height varies along the perimeter with the maximum height being 5.0 m. The bottom area of the TSF is 70m by 70m equivalent to 4,900 square metres with a TSF slope embankments of 1:2 and 1:3 for upstream and downstream edges respectively. The total area of the TSF including the embankments is approximately equals to 10,100 m^2. The design free board is 0.5 m and the top of starter dam elevation 1252.50 m being on the northern part of the TSF footprint. The elevation of the existing ground on the southern part of the TSF being 1252.50 m above mean sea level, therefore making it possible to utilize the cut slope in containing the tailings.

1.4 Scope of TSF Design

- To collect, measure, analyse data and information in order to analyse all technical, legal and environmental aspects of the proposed TSF design
- Preparation of site water management plan
- To check the stability and safety of the TSF based on the capacity given in the scoping report
- Preparation of engineering drawings and detailed sections of different parts of the designed TSF
- Preparation of a detailed design report which will be presented to the Ministry of Water (MoW) and Ministry of Minerals (MoM) for review and approval.

1.5 Water Quality

One of the important aspects of Tailings Storage facilities construction, operation and closure is hydrology and domestic water use. Baseline surface water and ground water quality is of crucial importance in order to avoid any future complaints which may arise. The baseline studies were undertaken during the dry season where all of the surface water sources didn't have water. In reference to the scoping report, the ground water table in the area falls between 70-100 metres below the original ground level, ground water through borehole will be used as a source for the proposed processing plant. Therefore, after drilling of the boreholes and prior to commencement of the plant operation activities, the baseline ground water qualities should be established.

Figure 1: Google earth image showing the site of the proposed design of Tailings Storage Facility (TSF) at Bumwa, Segese, Msalala, Tanzania with the relative locations of geotechnical investigation points and possible sources of soils for embarkment clay lining.

2.0 Chapter TWO: TSF Design Consideration

2.1 Design standards

Taking into consideration of the legal requirements guidelines and supporting principles discussed in Chapter One, the TSF has been designed in accordance with the Tanzanian Ministry of Water Dam Safety Guideline 2020. Other relevant guidelines such as the Australian Committee on Large Dams (ANCOLD) Guidelines including ANCOLD's Guidelines on Tailings Dam Planning, Design, Construction, Operation and Closure (ANCOLD, 2012) were also incorporated.

2.2 Site selection

The proposed TSF will be located on the north western side of the processing plant and other facilities. This ensures any storm water runoff from the TSF operations will be collected on site as the topography (Figure 2 & Figure 3) of the property slopes towards the north.

Figure 2: Aerial Topographical Survey map for Bumva-Segese -Aerial Orthomosaic

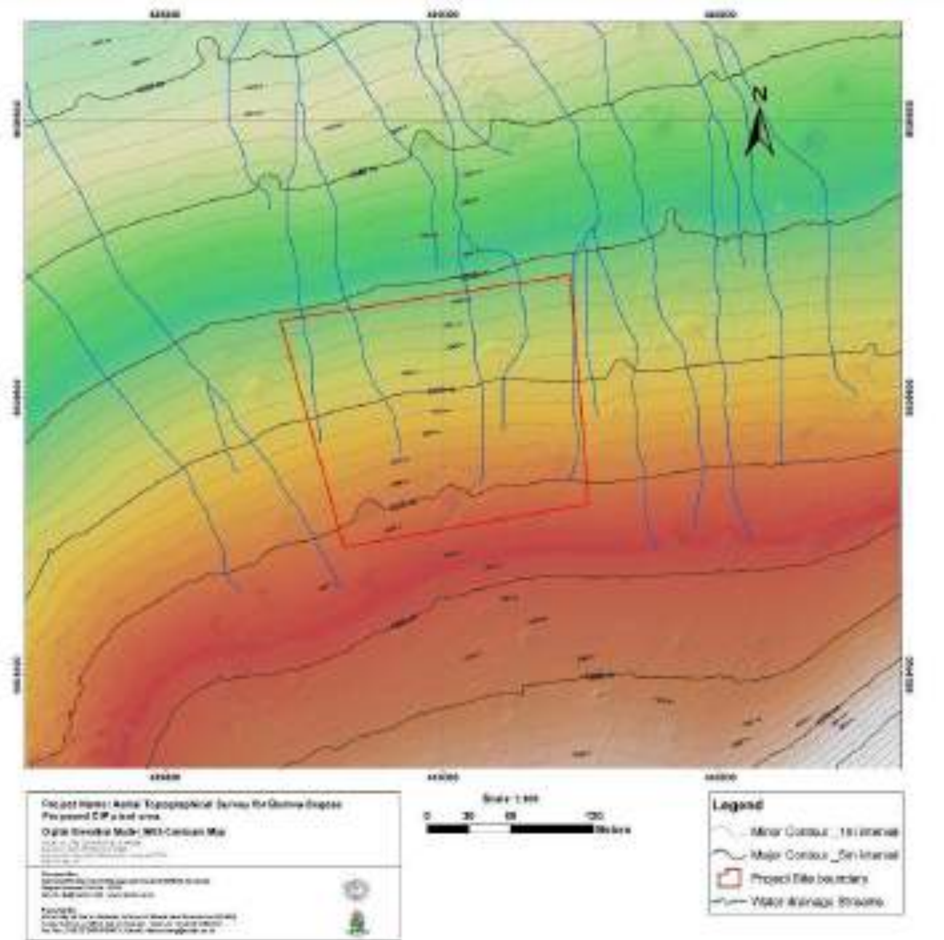


Figure 3: Aerial Topographical Survey for Bumva-Segese - Digital Elevation Model with Contours Map

2.3 General TSF design criteria and constraints

The key design criteria fundamental to overall life of TSF design are summarized in Table 1 based on;

- Climate data
- Seismicity
- Flood design criteria
- TSF classification

Table 1: General TSF design criteria

Item description	**Criteria / Constraint**
Climate	• Estimated mean annual precipitation: 998 mm • Estimated mean annual relative humidity: 64% • Estimated mean annual specific humidity: 12 g/kg • Estimated mean annual wind speed is 3.3m/s blowing at a mean annual direction of 115° from the north direction • Estimated mean annual surface air pressure: 88 kPa
Hazard classification consequence category	In accordance with the URT MoW Dam safety Guideline Table 2.2 the TSF classifies as Class C having Low to Very Low Risk with design inflow flood annual exceedance probability between 1/100 to 1/ 1000 years and Maximum Credible Earthquake (MCE) annual exceedance probability between 1/100 to 1 / 1,000 years
Design flood	• Inflow Design Flood (IDF) up to and including Year 1 = 1000 years event for 72-hour storm duration • Inflow Design Flood (IDF) during operations = One thirds between 1,000 years and the Probable Maximum Flood (PMF) event for 72-hour storm duration • Inflow Design Flood (IDF) for closure = Probable Maximum Flood (PMF) event for 24 hour storm duration

Item description	Criteria / Constraint
Seismic design	• Maximum Design Earthquake (MDE) = 1 / 1,000 years • Mean maximum firm ground acceleration = 0.18g, Magnitude = 6.3
Tailings production	The mine plant throughput capacity is expected to process 20 tonnes of ore per day. Assuming 95% availability of plant, it implies the throughput per annum is equivalent to 20 tonnes per day x 0.95 x 365 days per year = 6,935 tonnes per year
TSF Dimensions	The bottom area of the TSF is 70m by 70m equivalent to 4,900m square metres with a TSF slope embankments of 1:2 and 1:3 for upstream and downstream edges respectively
Average tailings slurry solids	45 % - 55 % (Solid to water ratio)
The achievable dry density of the ore	2.8 tonnes per cubic metre
The density of the slurry	1.41 tonnes per cubic metre
Site Water Management	• Zero discharge from TSF pond. Water from the TSF pond will be reclaimed back for processing. • Runoff water from the TSF area will be collected by the Return Water Pond and re-used for processing
Starter embankment rise	Rise varies along the perimeter with the maximum height being 5.0 m on the northern part of the TSF and the minimum crest height is 0 m on the southern part of the TSF from the exiting ground level
Uniform Embankment crest width	2.0 m
Tailings crest perimeter	419 m long
TSF ultimate (maximum) height	5.0 m
Excavated depth of the TSF	Maximum 3.5 m then varies
Embankment construction material	Overburden from the TSF footprint area and borrow pits
Construction schedule	Excavated pit and raised embankment construction
Water Management System and Monitoring Measures	Seepage collection systems include; • Surface drainage trenches • Groundwater monitoring wells (based on hydrogeological study)

Item description	Criteria / Constraint
Stability Analysis	The minimum acceptable factors of safety based on the ANCOLD "Guidelines on Tailings Dams" (2012) and CDA "Dam Safety Guidelines" (2007) which are as follows; During construction = 1.3 Long term (post closure) = 1.5 Post-earthquake (full liquefaction of tailings assumed) = 1.2
TSF Foundation / tailings deposition	Beach slope 1 %
TSF closure requirement	Detailed TSF closure plan is described

Table 2: Material requirements for the construction of an embankment for a TSF

Task / Part of the TSF	Criteria / requirements
Site clearance	Remove all top soils/rocks mixed with grasses or vegetation roots
Foundation for an embankment	The embankment should be laid at a minimum depth of 0.3m below the ground level. After excavation, the base should be well leveled or compacted to receive the embankment. The materials used should be weathered earth and rockfill excavated from inside the TSF footprint.
Crust of the embankment	- Insitu materials excavated rock/soil from the TSF footprint - The rock should be angular to enhance friction and interlocking between them - When a rock fill is used, there are large voids between the rock chunks that must be filled with fines. Fines, or coarse rock dust, will fill the sides and top of the embankment, but large voids may remain inside of the embankment. Care should be paid to this issue to ensure that no voids remain. Generally, deformations are not a problem, as the rock pieces will remain intact due to friction and interlocking between them. **Properties of the embankment fill materials**

	- The maximum diameter for rock in a rock fill embankment should be limited to under 1000mm. - Saturated unit weight = 19.0 kN/m^3 - Dry unit weight = 16.6 kN/m^3 - Permeability = 1.63×10^{-5}m/s - Stiffness of the soil = 5 MPa
Compaction Control - Crust of the embankment	- Compacted in lifts of 300mm thick - Compact to at least 95% MDD BS – Heavy • MDD = 2072kg/m^3 at an OMC of 9% - 4 days soaked CBR of min 7% must be achieved - The control of moisture content should be within ±2% of the optimal moisture content (OMC). If the material is too wet, then excess moisture should be removed with aeration. Alternatively, if the material is too dry, the moisture content can be boosted with watering and disking.
Clay liner	- 300mm thick compacted clay layer throughout the TSF (bottom and upstream sides) with a maximum coefficient of permeability of 6.6×10^{-8} m/s - Liquid limit (LL) = 40% to 50% - Plasticity Index (PI) = 20% to 30% - Compact to 0.95% of the MDD, MDD = 1780kg/m^3 at an OMC of 15.1%, The moisture content during compaction should be limited within ±2% of the OMC - 4 days soaked CBR of min 3% must be achieved

HDPE liner	- At least one layer of 1.5mm thick HDPE liner to be laid on top of clay liner layer.
	- Specifications of the required HDPE liner
	  • Yield strength = 22kN/m
	  • Yield elongation = 12%
	  • Break strength = 40kN/m
	  • Break elongation =700%
	  • Puncture resistance = min. 480N
	  • Tear Resistance = min. 187N

	• Dimensional stability = $\pm 2\%$ • UV resistance membrane
Decant tower	- 1200 mm diameter precast concrete slotted pipe surrounded by washed gravels with $d_{50\%}$ around 2 – 3 mm in turn surrounded by clean rockfill with $d_{50\%}$ up to 40mm.
Riprap stones	- Use of 300mm thick riprap stones layer on the downstream sides to protect the crust. - The density of rock used for riprap typically varies from about 2,400 kg/m^3 to 2,800 kg/m^3 - Stone for riprap should be hard, durable field or quarry materials. They should be angular and not subject to breaking down when exposed to water or weathering. The specific gravity should be at least 2.4. - Well-graded mixture. - Riprap should be inspected periodically for scour or dislodged stones. Control weed and grass growth as needed.
Monitoring boreholes	- Drill a borehole of 200mm diameter to a maximum depth of 100m, supply and install casing, submersible pumps to the fully operation of the pump
Access embankment to the decant tower	- Supply and construct a decant pond access embankment earthworks compacted in lifts of maximum of 0.3m height or as directed by the Supervising Engineer.
Return water pond	- Excavate a return water pond of 300m^2 to a minimum depth of 1.5m with side slopes of 1:1.5 - 300mm thick compacted clay layer throughout the return water pond with a maximum coefficient of permeability of 6.6 x 10^{-8} m/s - At least one layer of 1.5mm thick HDPE liner to be laid on top of clay liner layer - Restrict runoff water from entering the return water pond

2.4 The Observational approach and dam safety program

In accordance with ANCOLD 2012 the design and management of the TSF will utilize the observational approach. The observational approach allows the TSF to be optimized over time as monitoring information becomes available and the design and construction methodologies evolve. The observational approach allows any changes that might occur during the life of the TSF to be accommodated whilst meeting the design criteria and objectives over the entire life of the TSF.

2.5 Geology

Bumva - Segese local geology description by the geological map of Bukombe Quarter Degree Sheet 62 from the Geological Survey of Tanzania suggests the project area (Figure 4) consists of sandy soil overlying a diorite, coarse grained equi-grannular gray derived from granite through the crystallization of magma within the earth crust rich in plagioclase, clinopyroxene, hornblende and apatite minerals. On the southern part of the site, the geology of the site consists of green stone. Mafic to felsic and banded iron formations with one line interpreted as a fault.

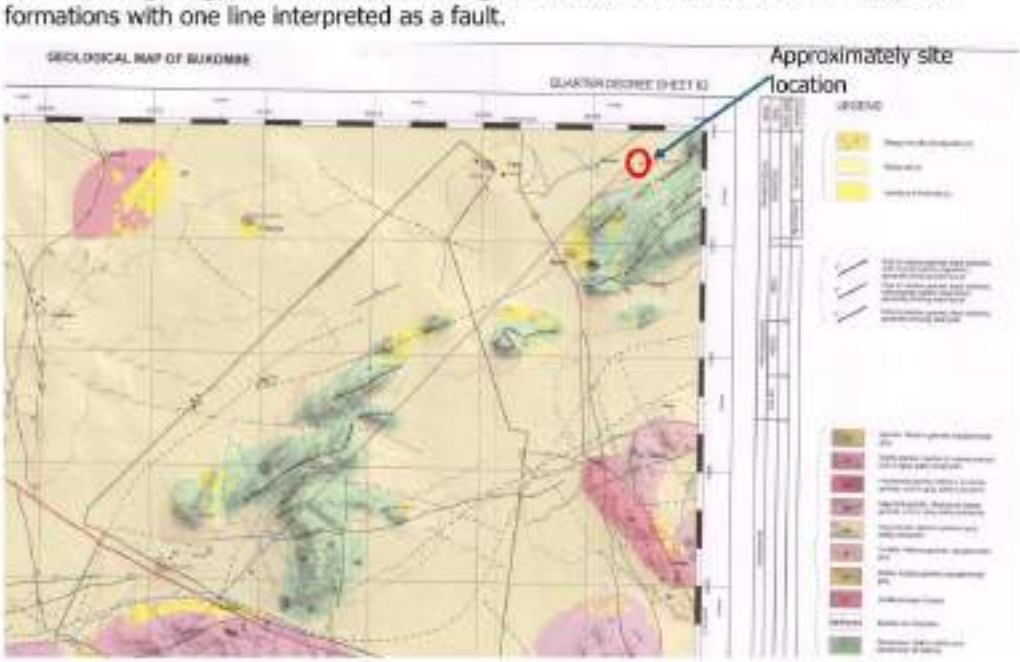


Figure 4: Extract from the Bukombe Quarter Degree Sheet 62 Geological Map of Tanzania (Geological Survey of Tanzania (GST), 1967)

2.6 Climate

Appendix II incorporates site weather information that summarises weather data from 2000 to 2022 with the data being presented as monthly averages over 22 years (NASA, 2023).

3.0 Chapter THREE: TSF Design and construction details

3.1 Dam Classification

In accordance with the United Republic of Tanzania Ministry of Water (MoW) Dam safety Guideline Table 2.2 the TSF classifies as Class C having Low to Very Low Risk with design inflow flood annual exceedance probability below 1/ 1000 years and Maximum Credible Earthquake (MCE) annual exceedance probability below 1 / 1,000 years.

Simplified studies shall be conducted for Class C dams when falling in the category of dams with a risk in accordance with the Water Resources Management Act No. 11 of 2009. For dams in Class C, only general layout drawings of the dam and outlet works together with material characteristics have to be provided. Therefore, the following studies have been undertaken by the MoW nominated project Approved Professional Person (APP) (Appendix I) and are to be submitted as attachments to a filled-in Form No. 2 for application for Tailings Storage Facility Construction Permit from the Director of Water Resources of MoW;

1) Topographic Survey
2) Geotechnical Site Investigation
3) Geochemical Analysis
4) Hydrological Study
5) TSF Design
6) TSF General Sections and Plans

Table 3: Design with consequence category (Source the United Republic of Tanzania Ministry of Water (MoW) Dam safety Guideline Table)

Dam Classification	Design Inflow Flood	Design Earthquake
Very High Risk "A"	Annual Exceedance Probability between 1/10000 and Probable Maximum Flood (PMF)	Annual Exceedance Probability of 1/10000 of Maximum Credible Earthquake (MCE)
High risk "B"	Annual Exceedance Probability between 1/1000 and 1/10000	Annual Exceedance Probability between 1/1000 and 1/10000 of MCE
Low Risk "C"	Annual Exceedance Probability between 1/100 and 1/1000	Annual Exceedance Probability between 1/100 and 1/1000 of MCE
Very Low Risk "D"	Annual Exceedance Probability of 1/100	Annual Exceedance Probability of 1/100 of MCE

3.2 Summary of design

A TSF with storage capacity of 22,000 cubic metres is proposed as follows. The mine plant throughput is 20 tonnes per day. Assuming 95% availability of plant, it implies that the throughput per annum is equivalent to 20 tonnes per day x 95% x 365 days per year = 6,935 tonnes per year. Taking the solid density of ore to be 2.8 tonnes per meter cubic with 45% solids, we get the density of the slurry to be 1.41 tonnes per cubic meter from which a volume of 4,918 cubic meters per year is determined. Therefore, for a five-year design life before raising the TSF, an estimated reservoir volume of 22,132 cubic meters is required assuming only 10% of the water will be recycled. Starter dam height varies along the perimeter with the maximum height being 5.0 m. The bottom area of the TSF is 70m by 70m equivalent to 4,900 square metres with a TSF slope embankments of 1:2 and 1:3 for upstream and downstream edges respectively. The total area of the TSF including the embankments is approximately equals to 10,100 m^2. The design free board is 0.5 m and the top of starter dam elevation 1252.50 m being on the northern part of the TSF footprint. The elevation of the existing ground on the southern part of the TSF being 1252.50 m above mean sea level, therefore making it possible to utilize the cut slope in containing the tailings. The working drawings are attached in the Appendix III .

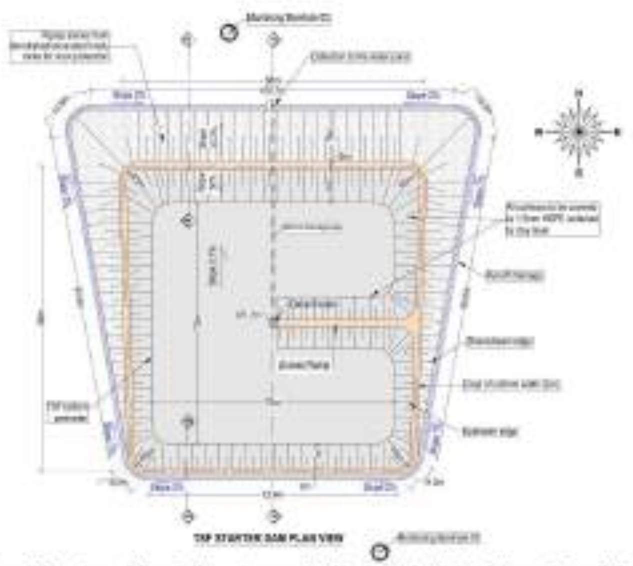


Figure 5: The Starter dam Plan view of the Tailing storage Facility to be built for Artisanal Small Scale Gold Miners mercury free Gold demonstration centre at Bumva, Segese in Shinyanga region.

Detailed Design Report for TSF at Segese in Shinyanga 23

3.3 Stability analysis

The perimeter embankment earth starter dam wall will have varied heights as shown on the general section and plans the least being 0 m from the ground level (Southern part of the TSF) and highest being 5.0 m from the ground level (Northern part of the TSF). Stability analysis will be considered at the critical section of the TSF embankment on the northern part with the crest elevation (1252.5 m) relative to the dam floor / wall toe as representative of the entire perimeter wall. A trapezoidal embankment earth dam wall section will be deployed throughout as per the representative sections shown on the general sections and plans; e.g. Figure 5 and Appendix III for a detailed description of the design drawings. The crest elevation is 1252.50 m on the southern part of the TSF however it utilizes the cut slope of the existing natural soil, slope stability analysis on this section has also been performed. Figure 6 summarises a free body diagram of the limit equilibrium forces on the critical section of the embankment dam wall based on which the stability analysis of the selected embankment dam wall cross-section is very stable throughout the design period of the TSF.

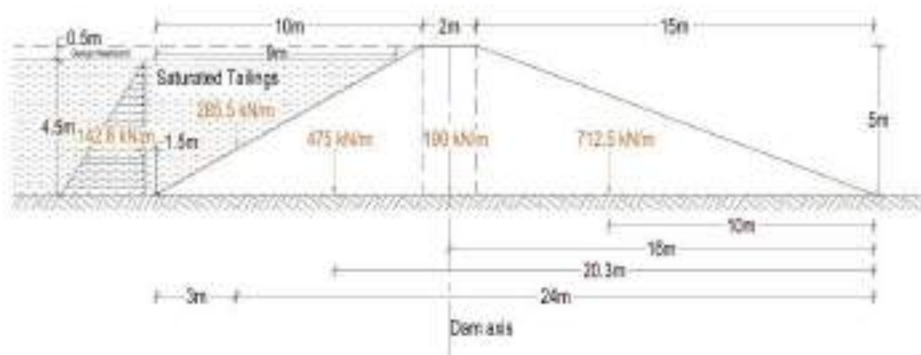


Figure 6: Equilibrium of forces on the critical section of the embankment starter dam wall (Northen part of the embankment)

Factor of Safety for overturning;

$$\text{FoS overturning} = \frac{\sum M_{restoring}}{\sum M_{mobilizing}}$$

$$= \frac{285.5 \times 24 + 475 \times 20.3 + 190 \times 16 + 712.5 \times 10}{142.8\ x\ 1.5}$$

$$\text{FoS overturning} = \frac{26659.5}{214.2} \ggg \ very\ stable$$

Factor of Safety for sliding;

$$FoS\ sliding = \frac{\sum F_{restoring}}{\sum F_{mobilizing}} = \frac{tan\varphi \sum V}{\sum H}$$

$Tan\varphi$ is the interface shear resistance given as 0.466 for gravels and coarse sands (assuming friction interface angle equals to angle of internal friction)

$$Fos\ sliding = \frac{0.466 \times 1663}{142.8} = 5.4 \quad stable$$

Bearing Capacity, contact pressure (σ_n) due to embankment loading

$$\sigma_n = \frac{285.5 + 475 + 190 + 712.5}{27} = 61.6kPa$$

$$\sigma_n = 62kPa < 320 \qquad Okay.$$

Contact stresses < Allowable bearing capacity

The slope stability analysis relies on the cross section of the embankment on the northern and southern part of the TSF. This serves as the critical sections for the analysis based on the physical possibility of the potential failures on the embankment side slopes. The embankment is considered to rest on the diorite rock overlying a clayey gravel soil. Therefore, a two layers of soil model were created with varying parameters to mimic the actual site condition.

Analysis type was based on Morgenstern Price and the governing code is BS 8006:1995 Section 7. In this analysis, trial slip surfaces are defined by the grid and radii method. Radii were produced within the clayey gravel soil where the varying radius of the circles measured from each point in the grid.

Analysis of a variety number of failure surfaces to identify the critical failure plane was carried out. A circular failure mechanism was typically the starting point for an analysis of several circles with varying radii and centers. The mechanism with the lowest global factor of safety is the critical one and it was ensured that the critical failure is surrounded by the yellow and green colors. The overall stability of the embankment slopes of the TSF as per analysis carried out shows that the slopes was safe (stable) with a factor of safety greater than 4.7 on the downstream slopes based on Slope/W analysis software as shown in Appendix IV - Figure 16.

3.4 Embankment rockfill dam raise

The design consists of raises to the existing embankment by downstream construction methods for 3 times with downstream and upstream slopes of 1:2 and 1:1.5 respectively. The initial raise will add around 3 meters to the existing dam embankment, followed by a second raise of approximately 2.2 meters above the first raise, and finally, a third raise of 2 meters from the top of the second raise as depicted in Figure 7. This preliminary design aims to confirm feasibility before implementation. With each raise accommodating a TSF capacity of about 22,000 cubic meters, the cumulative reservoir volume is estimated to reach approximately 88,000 cubic meters over a 20-year design life. The choice of rock / earthfill materials must adhere to the specified recommendations.

Stability analysis at each dam raise will be considered at the critical section of the TSF embankment on the northern part as representative of the entire perimeter wall. A trapezoidal embankment earth dam wall section will be deployed throughout as per the representative sections shown on the general sections. Table 4 provides stability checks for each raise. However, the calculations presented below are specifically focused on the third (final) embankment raise, which is deemed critical in terms of loading as shown in Figure 8. Refer Appendix III for a preliminary drawing for embankment dam raise that is to be done every after 5 years.

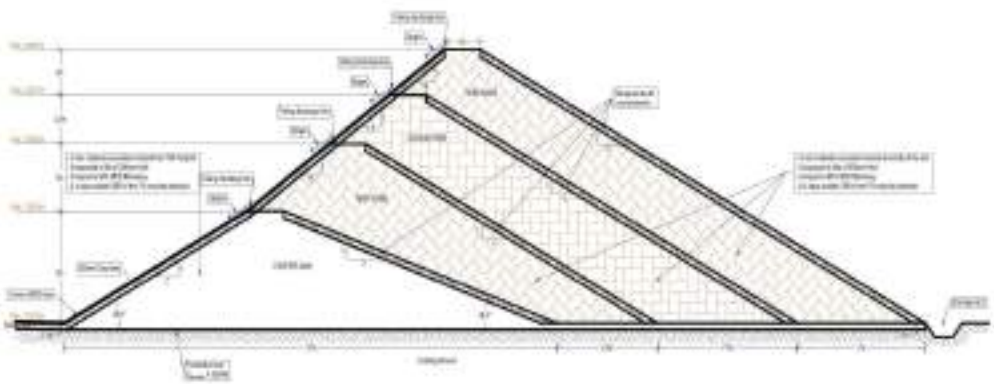


Figure 7. Cross section of the critical Northen TSF embankment dam raises by downstream construction methods to accommodate a design life of 20 years

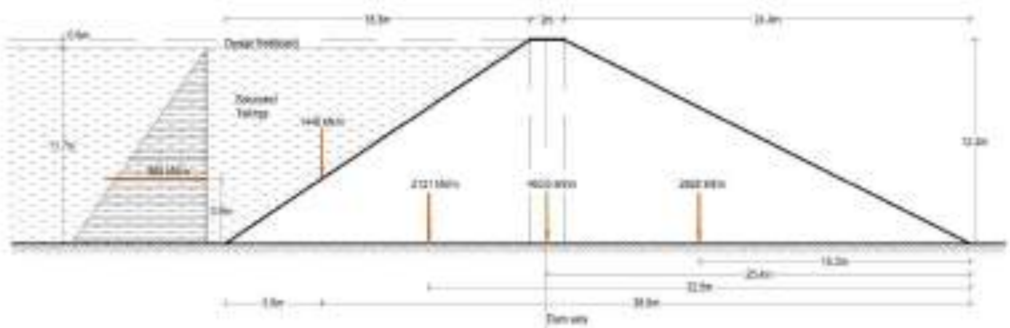


Figure 8. Equilibrium of forces on the critical section of the third raised northern embankment of the Tailing Storage Facility (TSF)

Factor of Safety for overturning;

$$\text{FoS overturning} = \frac{\sum M_{restoring}}{\sum M_{mobilizing}}$$

$$= \frac{1448 \times 38.9 + 2121 \times 32.5 + 463.6 \times 25.4 + 2828 \times 16.3}{965 \ x \ 3.9}$$

$$\text{FoS overturning} = \frac{183131.54}{3763.5} = 48.6 \ very \ stable$$

Factor of Safety for sliding;

$$FoS \ sliding = \frac{\sum F_{restoring}}{\sum F_{mobilizing}} = \frac{tan\varphi \sum V}{\sum H}$$

$Tan\varphi$ is the interface shear resistance given as 0.466 for gravels and coarse sands (assuming friction interface angle equals to angle of internal friction)

$$Fos \ sliding = \frac{0.466 \times 6860.6}{965} = 3.3 \quad stable$$

Bearing Capacity, contact pressure (σ_n) due to embankment loading

$$\sigma_n = \frac{1448 + 2121 + 463.6 + 2828}{44.7} = 153.5kPa$$

$$\sigma_n = 154kPa < 320 \qquad Okay.$$

Contact stresses < Allowable bearing capacity

The same stability analysis procedures were followed for each raise and the results are presented in Table 4.

Table 4. Stability analysis results at each embankment raise

No. of raise	Capacity for each raise (m^3)	Factor of Safety (FoS)		Contact stresses vs allowable bearing capacity	Remarks
		Overturning	Sliding		
1	24350	53.9	3.6	101<320kPa	Stable
2	22410	51.2	3.4	128<320kPa	Stable
3	22930	48.8	3.3	154<320kPa	Stable

3.5 Construction details

This stage of the TSF construction is to involve a starter wall of the dam only and therefore the construction can be considered as a centreline to downstream construction.

The dam will be entirely construction within the area of mining license of the mine owner and therefore there isn't acquisition of new right of way.

The general dimensions of the TSF are presented on the general plans and sections. The TSF is proposed to cover a footprint of approximately 4,900 square metres enclosed with a perimeter earth embankment dam of 419 m long which has a trapezoidal cross section with variable heights from the bottom level of the TSF ranging from 3.5 m to 5 m height while the base dimension ranges from 0 m to 27 m with a uniform crest width of 2.0 m.

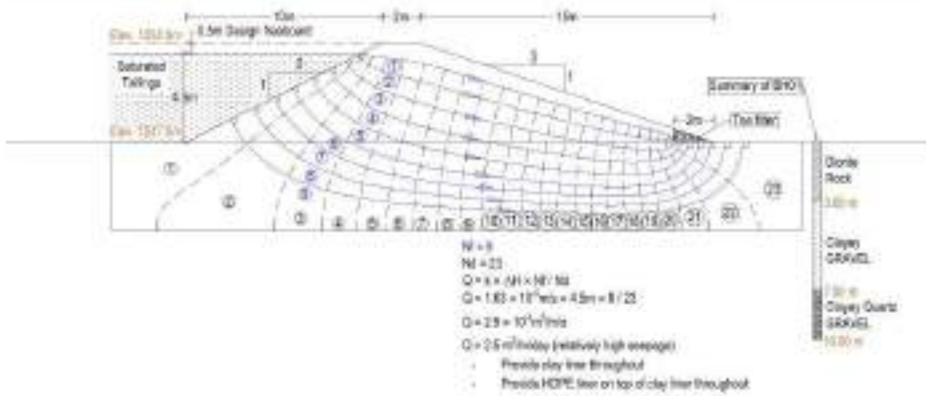
The type of impoundment adopted is a raised embankment and the deposition will be perimeter spigots around a decant tower and supernatant pond to allow sub-aerial tailing discharge which will lower the speed of the discharge and lead to good deposition sequence.

There being no existing structures at the location of the proposed TSF nor nearby houses or other public infrastructures there is neither relocation nor compensation expected to accrue from this construction and the land is clean as the ground surface is mostly covered by the rock. Table 5 - Appendix VI summaries the BOQ for the construction of the proposed TSF.

4.0 Chapter FOUR: Operational requirements

4.1 Seepage Flow Analysis and control

Figure 9 presents seepage analysis through a representative critical section of the embankment dam wall with a toe filter using a 2D flow net diagram with the permeability characteristics for the wall and the foundations as determined in the geotechnical site investigation report. The calculated seepage per meter width along the wall at the critical section is relatively high (~2.5 cum per m per day) suggesting the TSF should be lined to reduce / cut-off the seepage. Therefore, the base of the TSF is to be lined by a compacted 300mm thick clay liner and thereafter the entire TSF is to be lined by at a single layer of approved HDPE geo-membrane 1.50 mm thick as per Appendix V specifications.



SEEPAGE ANALYSIS ON CRITICAL SECTION (NORTHERN EMBANKMENT OF TSF)

Figure 9: Seepage flow net at the critical section of the dam (Northen embankment of the proposed TSF)

4.2 Liquefaction assessment of tailings

Given that the embankment wall is a starter dam the tailings are not invoked for stability analysis of the wall and therefore their liquefaction potential is not considered structurally impairing. Further, the substantial FoS realised with the dimensional cross sections selected implied the whole wall is far from failure even with a rare liquefaction potential of the tailings.

4.3 Decant tower design

Assuming P_{80} of 150 microns for tailings, to control the steepness of the grain size distribution; $\frac{D_{50\%\,Filter}}{D_{50\%\,soil}} < 25$. For filters in contact with a drainage pipe (well screen) the openings of the screen have to be $\frac{D_{85\%\,Filter}}{D_{opening\,of\,drainage\,pipe}} \geq 1\ to\ 2$. The Bumva - Segese tailings Particle Size Distribution are assumed to be as in Figure 10.

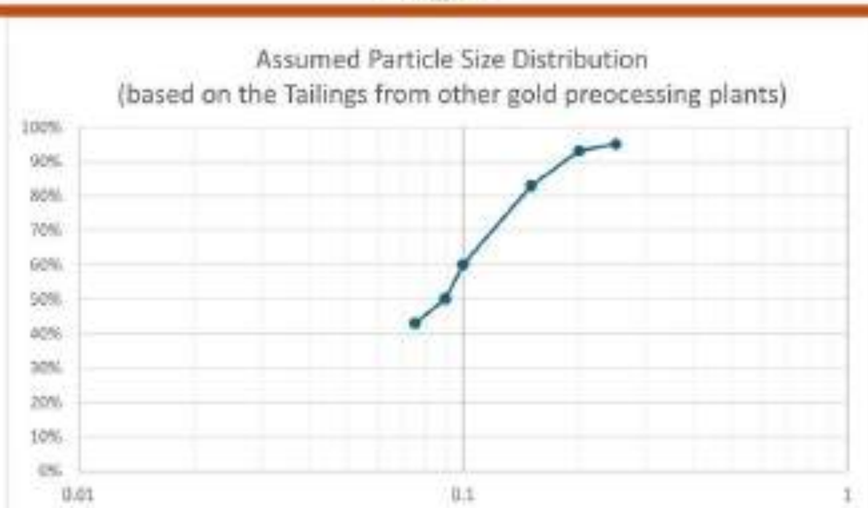


Figure 10: Particle Size Distribution of the assumed tailings at Bumva, Segese

The decant tower is designed by providing a simple access causeway to the decant tower from selected fill materials as used to construct the existing TSF wall. Erect a decant tower consisting of up to 1.2 m diameter slotted precast concrete pipe surrounded by washed gravels with $d_{50\%}$ around 2 – 3 mm in turn surrounded by clean rockfill with $d_{50\%}$ up to 40mm.

4.4 Site water management plan

4.4.1 Objective

Site water management plan is designed to effectively control all water within the Project area in an environmentally responsible manner. This includes the use of available water sources for processing. Water sources that will be controlled include;

- Surface water runoff, and
- Groundwater

Freshwater will be required to supplement process water requirements and to provide water to the plant throughout operations. Freshwater for use during plant operation will be supplied by groundwater from drilled boreholes. In reference to the scoping report, the ground water table in the area falls between 70-100 metres below the original ground level, ground water through borehole will be used as a source for the proposed processing plant.

4.4.2 Surface Water

The source of the surface water is the precipitation runoff which mostly occurs during the rainy season. Based on the surface terrain of the proposed TSF construction much of the runoff will be collected towards the northern part and therefore collection of surface drainage trenches will be excavated to ensure most of the surface runoff will be directed to collection storm water impoundment / return water pond.

4.4.3 Groundwater

The site area has a potential for ground water, in reference to the scoping report, the ground water table in the area falls between 70-100 metres below the original ground level. Ensuring that ground water is safe and protected from pollution the TSF will be lined to control seepage water if any also proposed monitoring borehole will be implemented on the northern area of the project.

Freeboard allowance and operating levels

The proposed TSF has been designed to be sufficient to contain unforeseen increases in the level and movement of fluid within the TSF caused by;

- Uncertainties in design rainfall estimates
- Uncertainties in design catchment and runoff estimates

The freeboard shall be designed by water balance calculations taking into account average and extreme conditions to prevent loss of free board during operations. However for small mines the data for water balance may not be available during planning and designing of TSF. Data can be collected during operation phase of the facility.

4.4.4 Freeboard definition based on 2020 Dam Safety Guidelines of Tanzania

The 2020 Dam Safety Guideline of Tanzania states that the total freeboard of a TSF is defined as the vertical height between the waterline and the top of the embankment crest (internal).

Total freeboard = Beach freeboard + operational freeboard

Whereby beach freeboard is defined as the vertical height between the waterline and the beached tailings against the embankment facility. The proposed TSF has been designed taking into account average and extreme conditions to prevent loss of freeboard during operation. The minimum freeboard has been designed based on rainfall of annual exceedance probability of 1 / 1000 of a 72 hours duration storm.

The proposed TSF freeboard has been calculated based on the probable maximum precipitation computations. In order to care of extreme wet weather conditions and 1: 1000 for 72 hours rainfall, extreme values have been adopted for the design of freeboard. Based on the computation the depth of the extreme rainfall event to be accommodated on the TSF is 300 mm. The total freeboard is computed between the Maximum Operational Pond Level and the crest of the embankment;

Summary for TSF freeboard

Item	Depth (m)
Storm (1 in 1,000 years 72 hrs maximum storm)	0.30
Maximum pool depth	0.15
Allowance for settlement of the embankment wall	0.025
Total freeboard	0.50

4.4.5 Site water management infrastructures design

Site water management infrastructures design is a very crucial aspect in the overall TSF design. The infrastructures ensures that all potential contaminated water is contained onsite. The main water management infrastructures associated with the proposed TSF design includes Site surface water drainage (SWD) system, Surface Water Impoundments (SWI) and Return Water Pond (RWP).

Return Water Pond (RWP)

Return Water Pond (RWP) has been designed to collect water from the Tailings Storage Facility from Surface Water Impoundments and from direct precipitation. The RWP will be located downstream of TSF to effectively utilize the downstream gradient.

Supernatant Water

The control of the supernatant pond is probably one of the most important procedures in managing the proposed TSF. Inadequate pond control can result in overtopping, increase in pore pressures, reduction of freeboard, high seepage rates and embankments settlements. These consequences can lead to instability and high risks of problematic situations occurring. For a conventional impoundment procedure, it is essential that the ponded water freeboard be sufficiently low (1.0 m) all along the tailings embankment.

Pumping Water Recovery Method

The proposed TSF will use a pumping system to recover water to the processing plant unit and return water to the pond. Due to the slope of the TSF beach water will be collected mostly in the centre of the TSF. The collected water will be conveyed through gravity to the Return Water Pond. From the return water pond water will be pumped to the processing plant as make up water.

Pump design

A "Warman" heavy duty high head lined slurry pump has been selected for the design. The Warman HH/H/HRM pump lines have been designed to produce high heads per stage at high pressures. Commonly used for long distances transport lines, the Warman pump lines can often satisfy application duties with a single pump where others require multiple pumps in series.

Water Quality Management

Approximately 40% of water entering the TSF is tailings slurry water. During operations, the TSF will have a net water surplus during the storm events. Water from the TSF will be given a priority on processing plant due to the following facts; (i) according to ANCOLD guidelines (2012), the facility should remain dry with very small amount of water that cannot be pumped back to plant due to depth; and (ii) the reclaimed water may have some level of Cyanide so the plant will require small amount of Cyanide during dosing. Otherwise, excess water will be stored in the Return Water Pond (RWP) during the very wet months.

Erosion Control

TSF will take in to account management of surface runoff on the top surface and down the sides. It is evident that severe erosion could occur not only of the relatively steep side slopes of the main embankment with sever gully erosion but also of the sides of the drainage channel. These issues are crucial to the design of erosion control measures. The main factors that are incorporated in the TSF design to minimize risks of erosion includes;

- Low slope angles and advancing cone tailings structures
- The spreading nature of the slope as a result of the conical geometry
- The use of riprap stones on the downstream sides to protect the crust

4.5 Instrumentation and monitoring

4.5.1 Geotechnical Instrumentation and testing

Geotechnical instrumentation and monitoring will be undertaken during operation phase of the project i.e. during construction, operation and closure. The instrumentation monitoring will be undertaken to assess embankment performance and to ensure early identification of deviations to the original design. Based on the location and TSF design, the geotechnical instrumentation will comprise of;

- Movement (survey) monuments
- Groundwater Monitoring Wells
- Vibrating Wire Piezometer

Movement Survey Monuments (MSM)

Movement survey monuments will be installed along the embankment crests and downstream faces in order to monitor deflections along the slope and crest of the embankment. The periodic surveying of the monument's positions will provide early warning of any movement and possible acceleration of movement which often occurs prior to failure.

Groundwater Monitoring Wells (GMW)

Groundwater Monitoring Wells (GMW) will be installed at appropriate locations along the downstream toes of the TSF embankments. A schedule environmental monitoring program will be implemented, where by ground water samples will be collected and submitted to an accredited laboratory for analysis, the analysis will be used to monitor any deviations from normal of the TSF design and baseline water quality data

Vibrating Wire Piezometer (VWP)

The Vibrating Wire Piezometer (VWP) will be installed within the four TSF embankment walls. The VWP are mainly used to measure pore water pressures during the initial material placement, during the operations and post closure. The VWP will be distributed throughout the four embankment walls in order to provide realistic representative set of data for immediate decision making in case of any fault.

4.5.2 TSF Monitoring Program

In order to ensure stability of the TSF and environmental protection the following programs have been designed to monitor the performance of the TSF i.e. solid tonnage reporting to the facility, water volume reporting to the facility, site rainfall and evaporation data and water return to the facility

4.5.3 TSF-Embankment Monitoring

TSF embankment stability will be monitored using movement survey monuments which will be installed along the embankment crests and on the downstream faces. The monuments will be used to monitor the prevailing pore water pressure on embankment material and subsequent movements of the embankments.

4.5.4 Hydrogeology and groundwater Monitoring

A detail hydrogeology study was undertaken to determine nature of existing groundwater within the proposed project area (the approximate depth to groundwater is between 70m -100 m). The study assisted in identifying the important areas drilling ground water monitoring boreholes. Two sets of monitoring wells will be constructed i.e. shallow wells which will be used to monitor shallow aquifer and deep monitoring wells which will be used to monitor the deeper aquifer.

5.0 Chapter FIVE: TSF closure Plan

In reference to the scoping report prepared by the School of Mines and Geosciences, University of Dar es salaam, the closure of the project may entail complete shutdown of the demonstration centre, change of use, or both. In case of shutdown of the plant, UDSM shall pull down the industrial establishment, remove all machines and equipment from the site, and restore the site. UDSM shall prepare a decommissioning plan (to be approved by NEMC or the Msalala DEMO) to guide the implementation of the activity.

6.0 Conclusions and recommendations

The following conclusions and recommendations emanate from the detailed design of tailings storage facility (TSF) for mercury-free gold processing demonstration centre at Bumva Village, Segese Ward, Msalala district in Shinyanga region, Tanzania.

1. In accordance to the United Republic of Tanzania Ministry of Water (MoW) Dam safety Guideline Table 2.2 the TSF classifies as Class C having Low to Very Low Risk with design inflow flood annual exceedance probability below 1/ 1000 years and Maximum Credible Earthquake (MCE) annual exceedance probability below 1 / 1,000 years.

2. A TSF with storage reservoir volume of 22,000 cubic metres is required. The general dimensions of the TSF are presented on the general plans and sections. The TSF is proposed to cover a footprint of approximately 4,900 square metres enclosed with a perimeter earth embankment dam of 419m long which has a trapezoidal cross section with variable heights from the bottom level of the TSF ranging from 3.5 m to 5.0 m height while the base dimension ranging from 0 m to 27 m with a uniform crest width of 2.0 m.

3. Based on the stability analysis on the selected embankment starter dam wall cross- section the contact stresses are less than the allowable bearing capacity (62kPa < 320kPa) therefore the dam is very stable throughout the design period of TSF.

4. Based on the preliminary stability analysis of raising the embankment dam three times using downward construction methods every after 5 years, results indicate that the embankment wall will be stable over a 20-year design life.

5. The overturning analysis of the starter embankment wall has a factor of safety of approximately 124 signifying that the embankment wall is very stable against overturning and the dam was confirmed to be stable against sliding failures with a factor of safety of 5.4.

6. The overall stability of the embankment slopes of the TSF starter dam as per analysis carried out shows that the slopes was safe (stable) with

a factor of safety greater than 4.7m on the downstream slopes of the critical section of the embankment based on Slope/W analysis software.

7. The calculated seepage per meter width along the wall at the critical section is relatively high (~2.5 cum per day) suggesting the TSF should be lined to reduce / cut-off the seepage. Therefore, the base of the TSF should be line by 300mm thick clay liner and after the entire TSF is to be lined by at least a single layer of approved HDPE geo-membrane 1.50 mm thick as per Appendix V specifications.
8. The substantial FoS realised with the dimensional cross sections selected implied the whole wall is far from failure even with a rare liquefaction potential of the tailings.
9. TSF construction is to involve a starter wall of the dam only and therefore can be considered as a centreline to downstream construction within the area of mining licence of the mine owner.
10. Given particle distribution of tailings information from other gold processing plants of 150 microns a simple access causeway to decant tower consisting of up to 1.8m diameter slotted precast concrete pipe surrounded by washed gravels with $d_{50\%}$ around 2 – 3 mm in turn surrounded by clean rockfill with $d_{50\%}$ up to 40mm from selected fill materials should be provided.

7.0 References

7.1 Google Earth © 2024 accessed January 2024.

7.2 Geological Survey of Tanzania (GST) 1967. Geological Map of Bukombe Quarter Degree Sheet 62.

7.3 NASA. 2023. Prediction of Worldwide Energy Resource (POWER) and Agroclimatology Community [Online]. Available: https://power.larc.nasa.gov/data-access-viewer/ [Accessed 05th January 2023].

7.4 The United Republic of Tanzania Ministry of Water (MoW) Dam safety Guideline

Appendix I – Site Location

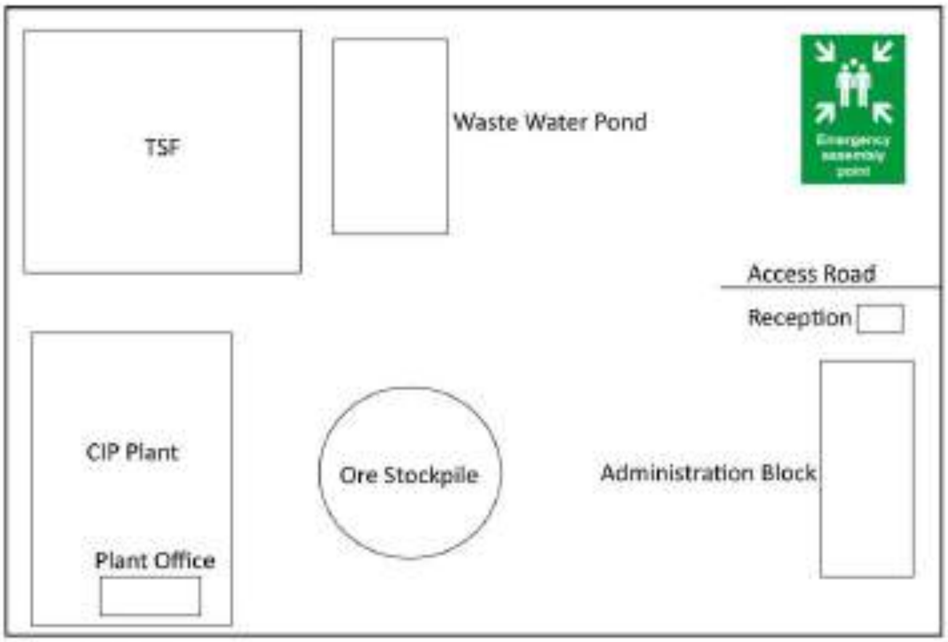


Figure 11: Schematic layout of the proposed Artisanal and Small-scale Gold Mining mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region.

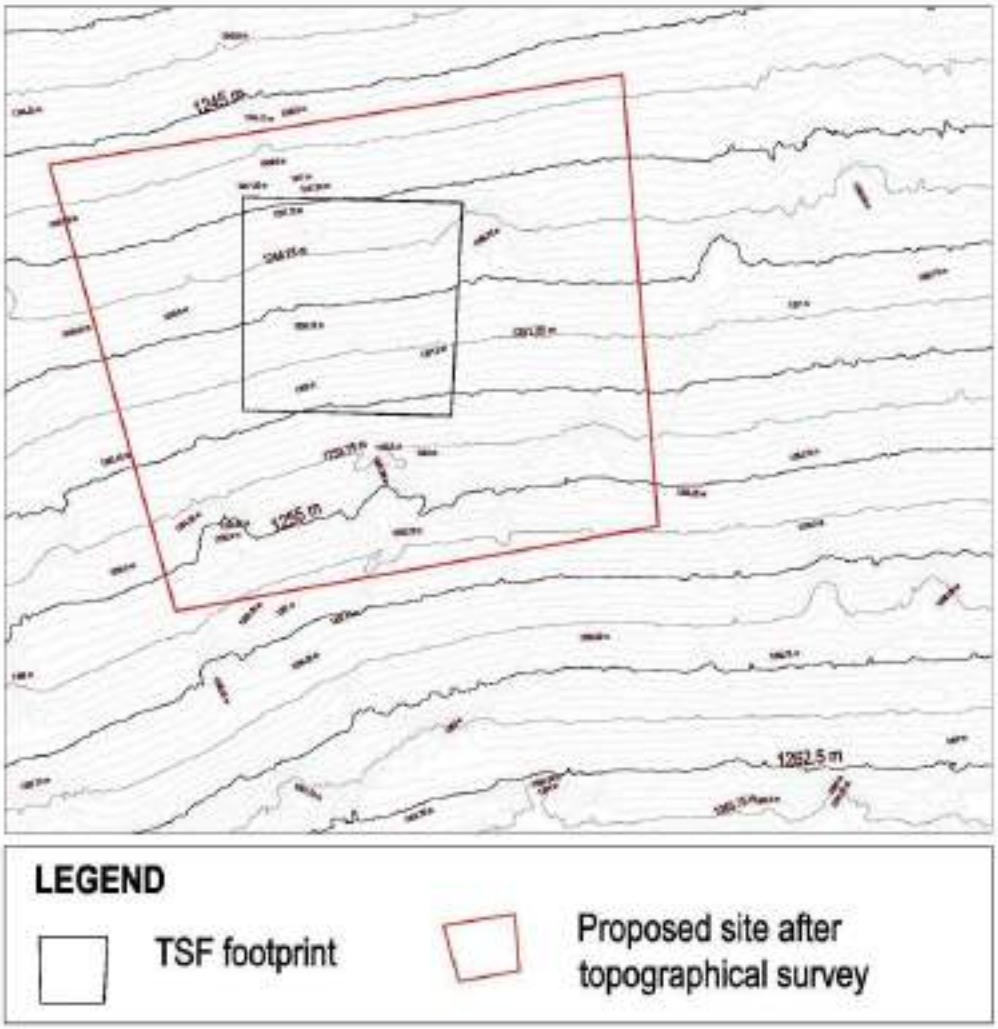


Figure 12: The location of the TSF in respect to proposed site boundary

Appendix II - Site weather

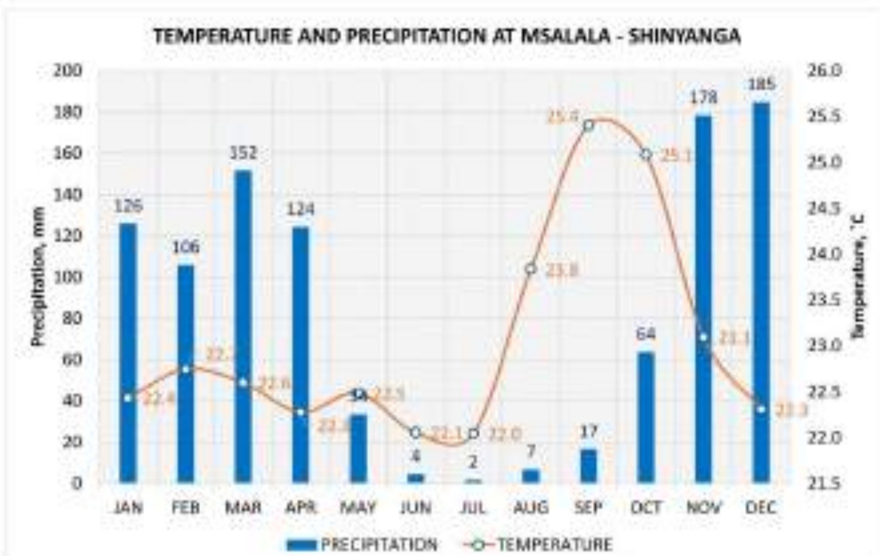


Figure 13: Average monthly temperature and precipitation from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

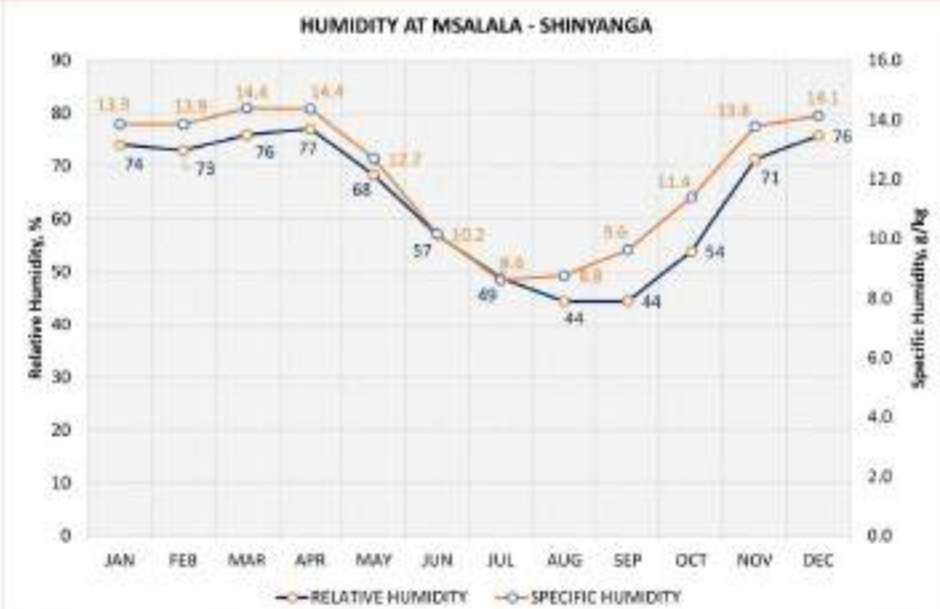


Figure 14: Average monthly relative and specific humidity from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

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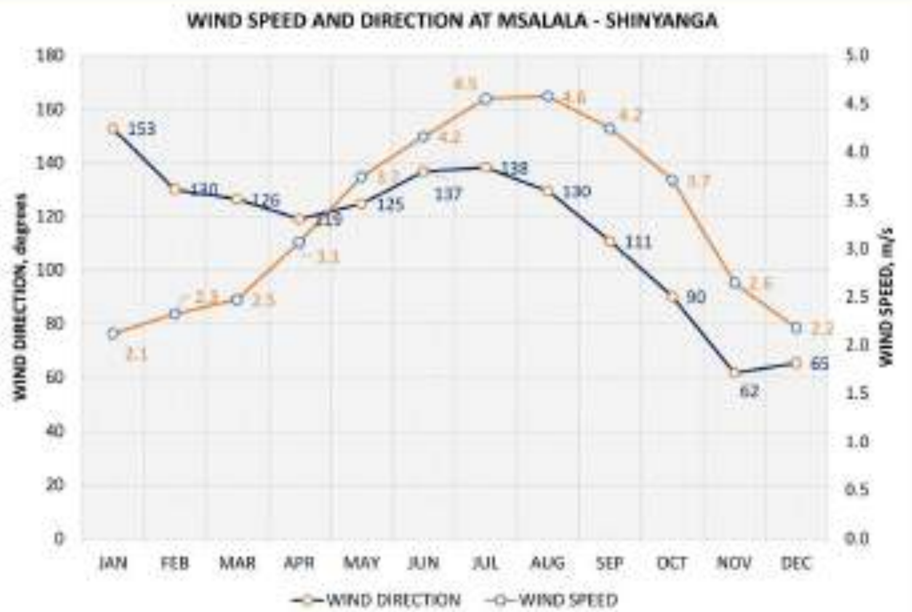

Figure 15: Average monthly wind direction and wind pressure from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

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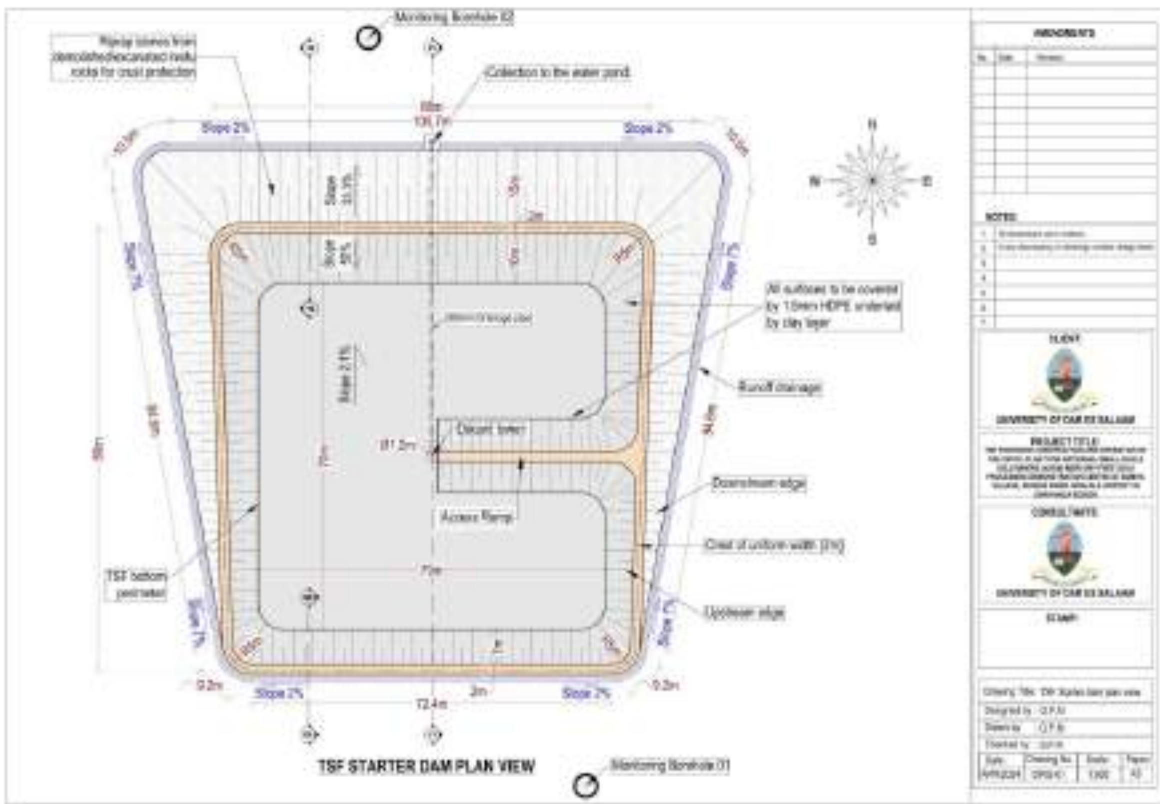
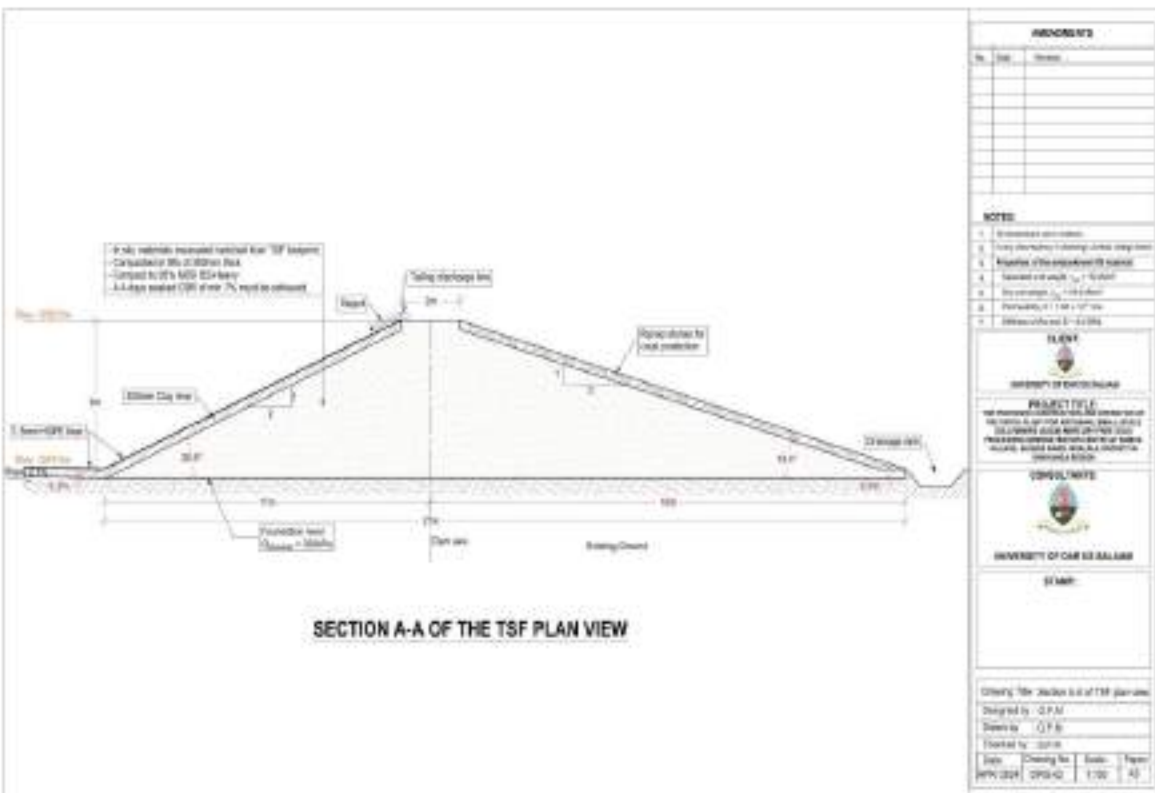
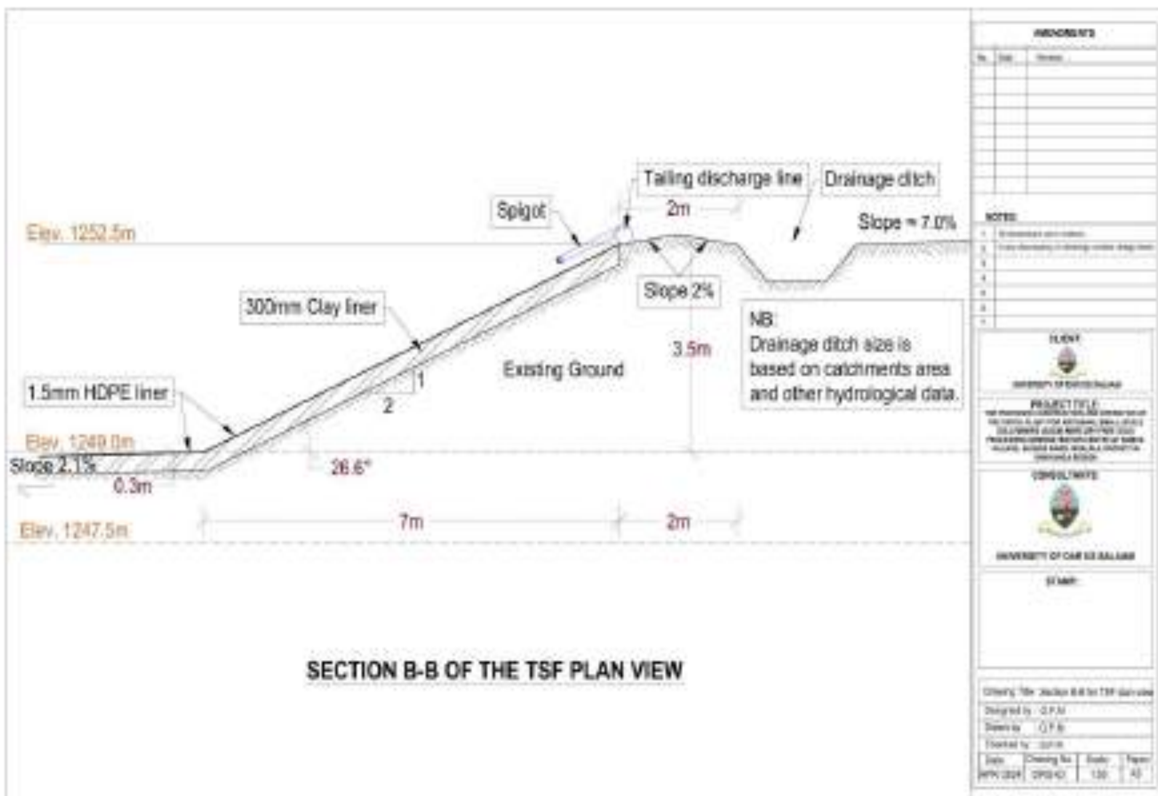
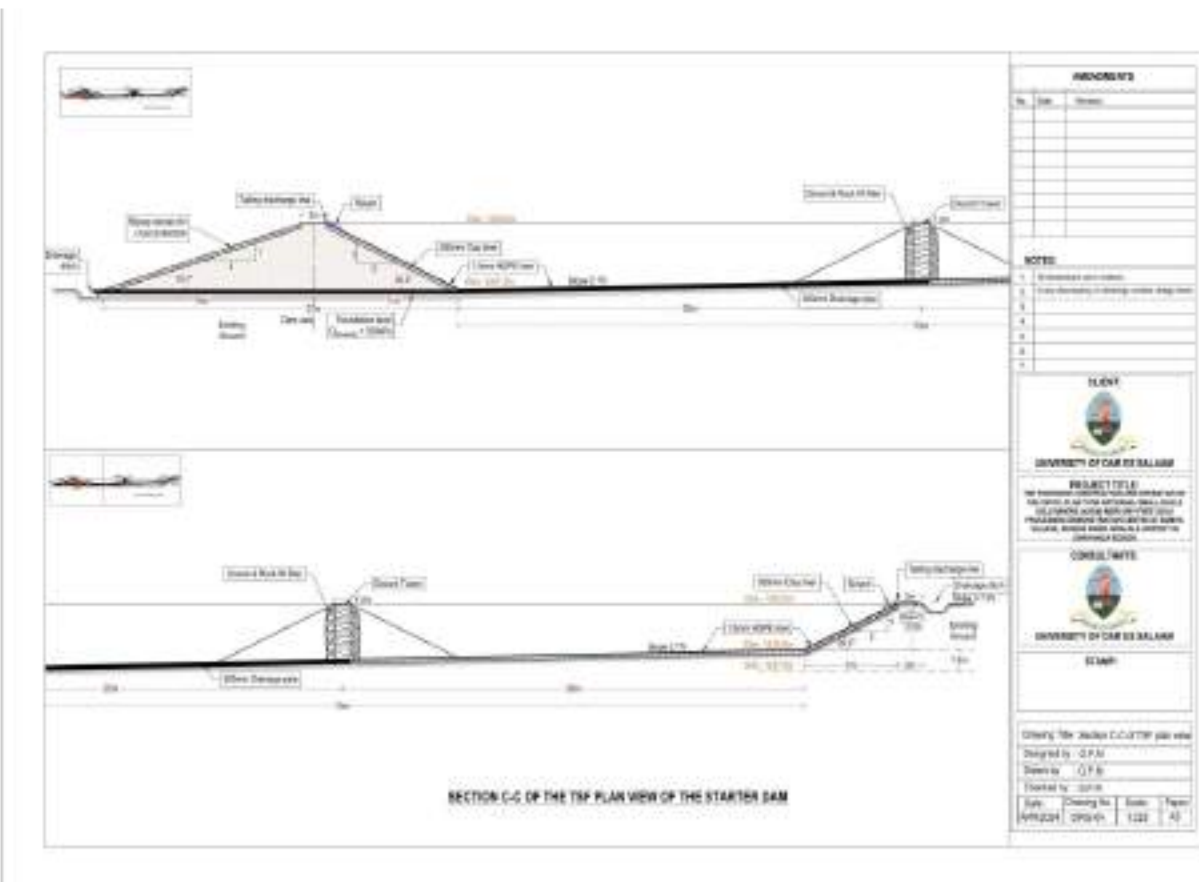
Appendix III – Design drawings


Monitoring Borehole 02
Collection to the water pond
Slope 2%
Slope 2%
N
W
E
S
All surfaces to be covered by 1.5mm HDPE underlaid by clay layer
Runoff drainage
Decant tower
Downstream edge
Access Ramp
Crest of uniform width (2m)
TSF bottom perimeter
Upstream edge
Slope 2%
Slope 2%
TSF STARTER DAM PLAN VIEW
Monitoring Borehole 01
AMENDMENTS
NOTES:
CLIENT
UNIVERSITY OF DAR ES SALAAM
PROJECT TITLE:
CONSULTANTS
UNIVERSITY OF DAR ES SALAAM
STAMP



SECTION A-A OF THE TSF PLAN VIEW


Tailing discharge line
Drainage ditch
Spigot
2m
Slope = 7.0%
Elev. 1252.5m
Slope 2%
300mm Clay liner
NB:
Drainage ditch size is
based on catchments area
and other hydrological data.
3.5m
Existing Ground
1.5mm HDPE liner
1
2
Elev. 1249.0m
Slope 2.1%
26.6°
0.3m
7m
2m
Elev. 1247.5m
SECTION B-B OF THE TSF PLAN VIEW
AMENDMENTS
NOTES:
CLIENT
PROJECT TITLE:
CONSULTANTS
UNIVERSITY OF DAR ES SALAAM
STAMP:


AMENDMENTS
NOTES
CLIENT
UNIVERSITY OF DAR ES SALAAM
PROJECT TITLE
CONSULTANTS
UNIVERSITY OF DAR ES SALAAM
STAMP
SECTION C-C OF THE TSF PLAN VIEW OF THE STARTER DAM

Appendix IV - Slope stability

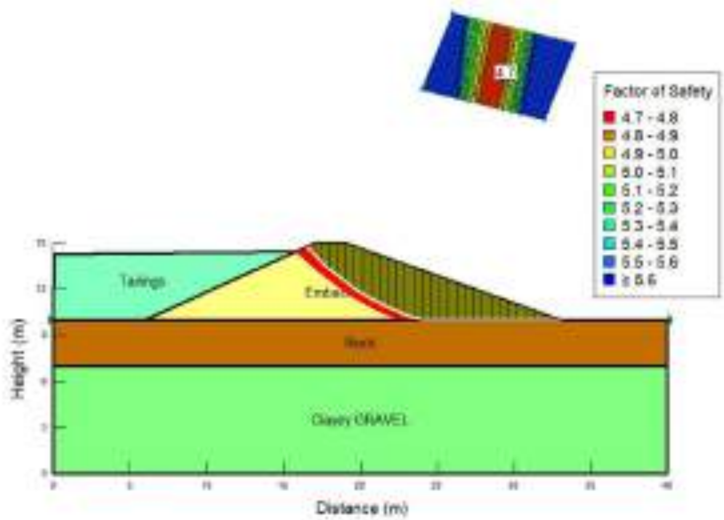


Figure 16: Slope stability analysis results on the downstream side of the critical embankment (Northen embankment of the TSF)

Appendix V – HDPE Specifications

POLYTEX
Plastics Co., Ltd.

B-506 Terra Tower II, 201 Songpa-daero, Songpa-gu, Seoul, 05854, Korea
TEL: +82 (0) 2 406 7984 FAX: +82 (0) 2 406 7987
polytex@polytexintl.co.kr / www.polytex.net

HDPE GEOMEMBRANE

Product Description

- Geomembrane is a kind of waterproof material with basic raw material of high molecular polymer. It is mainly divided into HDPE geomembrane, EVA geomembrance and so on.
- Applied in the projects of landfill waste site, bank, dam, pool, filth treatment site, tailings depot, subway and tunnel etc.

Features

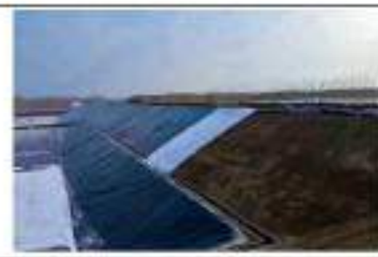
- Excellent environmental stress resistant cracking performance and chemical erosion resistance.
- Wide application temperature and long service life.

Product specification

Material HDPE

Width 1~ 8m / Regular width : 5.9m, 6m, 7m

Photo



Technical specification (GRI-GM13)

Item	Test Standard ASTM	GMS0.5	GMS0.75	GMS1.0	GMS1.25	GMS1.5	GMS2.0	GMS2.5
Thickness ≥ (mm)	D5199	0.50	0.75	1.00	1.25	1.50	2.00	2.50
Density ≥(g/cc)	D1505	0.940						
Tensile Properties (Each direction)(≥)	D6693 Type IV							
1.Yield strength(KN/m)		8	11	15	18	22	29	37
2.Break strength(KN/m)		14	20	27	33	40	53	67
3.Yield elongation(%)		12	12	12	12	12	12	12
4.Break elongation(%)		700	700	700	700	700	700	700
Tear Resistance≥(N)	D1004	64	93	125	156	187	249	311
Puncture Strengh≥(N)	D4833	160	240	320	400	480	640	800
Stress Crack Resistance hr.(≥)	D5397	500						
Carbon Black Content≥ (%)	D1603	2.0-3.0						
Carbon Black Dispersion ≥	D5596	Note(1)						
Oxidative Induction Time(OIT)≥								
(a)Standard OIT(min.)	D3895	100						
(b)High Pressure OIT	D5885	400						

Note(1): Carbon black dispersion(only near spherical agglomerates) for 10different views: 9 in Catefories 1 or 2 and 1 in Category 3

AKS Lining Systems (Pty)Ltd
SPECIALIST MANUFACTURER OF THERMOPLASTIC LINERS

GRI-GM13

Flat Die Extruded Smooth Geomembrane — Technical Data

Smooth Geoliner is produced from HDPE resin conforming to the requirements of the GRI-GM13 specification.

Properties	Units	Test Method	Test Frequency	Min Average Values				
Thickness. Minimum Avg.(a)	mm	ASTM D 5199	Per roll	1	1.5	2	2.5	3
Formulated Density	g/cc	ASTM D 792 ASTM D 1505	90 000kg/ approx. every 60 rolls	≥0.94	≥0.94	≥0.94	≥0.94	≥0.94
Tensile Properties - Minimum Avg. (b)								
+ Yield Strength	kN/m	ASTM D 6693	9 000kg/ approx. every 6 rolls	15	22	29	37	44
+ Yield Elongation	%	Type IV		12	12	12	12	12
+ Break Strength	kN/m	Dogbone		27	40	53	67	80
+ Break Elongation	%			700	700	700	700	700
Tear Resistance. Minimum Avg.	N	ASTM D 1004	20 000kg/ approx. every 12 rolls	125	187	249	311	374
Puncture Resistance. Minimum Avg.	N	ASTM D 4833	20 000kg/ approx. every 12 rolls	320	480	640	800	960
Dimensional Stability	%	ASTM D 1204	every 40 rolls	±2	±2	±2	±2	±2
Rapid tensile test (300mm/min)	visual	ASTM D 6693	90 000kg/ approx. every 60 rolls	No Separation Visible				
Carbon Black Content	%	ASTM D 4218	9 000kg/ approx. every 6 rolls	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3
Carbon Black Dispersion	Category	ASTM D 5596	20 000kg/ approx. every 12 rolls	cat.1 / cat.2	cat.1 / cat.2	cat.1 / cat.2	cat.1 / cat.2	cat.1 / cat.2
Oxidative Induction Time (OIT)								
Standard OIT — and —	minutes	ASTM D 3895	90 000kg/ approx. every 60 rolls	>100	>100	>100	>100	100
High Pressure OIT	minutes	ASTM D 5885		>400	>400	>400	>400	400
Stress Crack Resistance (SP - NCTL)	Hours	ASTM D 5397 Appendix	180 000kg/ approx. every 120 rolls	500	500	500	500	500
Oven Aging at 85°C (c)		ASTM D 5721	Per Formulation					
Standard OIT (min. avg.) retained after 90 days — or —	%	ASTM D 3895		55	55	55	55	55
High Pressure OIT (min. avg.) retained after 90 days	%	ASTM D 5885		80	80	80	80	80
UV Resistance - % retained after 1600 hrs.		ASTM D 7238	Per Formulation					
High Pressure OIT (min. avg.)	%	ASTM D 5885		50	50	50	50	50

a) Lowest individual of 10 values = -10%
b) Tensile results based on Avg values between MD and TD.
c) AKS Lining Systems has the right to select either test method to evaluate OIT.

Management System ISO 9001:2015 — TÜVRheinland CERTIFIED

All values are nominal, except when specified as maximum or minimum.
The information provided for reference purposes only and is not intended as a warranty or guarantee. Final decision on suitability of product remains the sole responsibility of user. AKS Lining Systems assumes no liability in connection with the use of this information.

Please contact our Sales Engineers for your specific containment application at:

Email: info@aks.co.za
Tel: +27 21 983 2700

18 London Circle, Brackengate Business Park
Brackenfell, Cape Town, South Africa
www.aks.co.za

Technical data refers to average values, measured across the manufactured width of the sheet. This information is expressed as a guide and based on values measured in our laboratory as well as independent laboratories. The quoted values are based on specific resin properties and are subject to change without prior notice.

Approved by: Managing Director — All printed copies are uncontrolled — [illegible]

NABAKI AFRIKA
Quality Building Products

AKS Linings & Polytex
Price List

Item Code	Description	Desc 2	Price Incl. VAT
297031	Smooth HDPE Geomembrane 1 mm - 1 m x 7 m	AKS	94,500
297035	Smooth HDPE Geomembrane 1 mm - 7 m x 220 m roll	AKS	16,275,000
297040	Smooth HDPE Geomembrane 1.5 mm - 150 m x 7 m roll	AKS	14,595,000
297041	Smooth HDPE Geomembrane 1.5 mm - 1 m x 7 m	AKS	136,500
297060	Smooth HDPE Geomembrane 2.0 mm - 100 m x 7 m roll	AKS	12,495,000
297061	Smooth HDPE Geomembrane 2.0 mm -1 m x 7 m	AKS	178,500
297065	Smooth HDPE Geomembrane 2.5 mm - 70 m x 7 m roll	AKS	10,710,000
297070	Smooth HDPE Geomembrane 3 mm -73 m x 7 m roll	AKS	15,750,000
297150	Smooth HDPE Geomembrane 5mm - 25 m x 2.95 m roll	AKS	3,874,500
297160	HDPE Anti-Slip Liner 5 mm 20 m x 2.5 m Roll	AKS	4,504,500
297170	Smooth HDPE Seculock 4 mm 5.7 m x 138 mm	AKS	124,950
297180	HDPE Welding rod, Black (4 mm or 5 mm) 10 kg	AKS	304,500
880615	Smooth HDPE Geomembrane 0.5 mm -200 m x 5.9 m roll	Polytex	5,600,000
880616	Smooth HDPE Geomembrane 0.5 mm -1m x 5.9 m roll	Polytex	35,000
880620	Smooth HDPE Geomembrane 1.5 mm -100 m x 5.9 m roll	Polytex	7,810,000

Nabaki Afrika Ltd
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Email: info@nabaki.co.tz

AKS Linings Price List
Feb 14
NB: Prices are subject to change without notice

Appendix VI - Estimates for construction of an earthfill embankment.

Table 5: Estimates for the construction of a proposed TSF

Bill No. 1: Preliminary and General Items

Item no.	*Description*	*Unit*	*Quantity*	*Rate (TZS)*	*Amount (TZS)*
1	**PRELIMINARY AND GENERAL ITEMS**				
1.1	Performance Bonds costs	LS	1		
1.2	Mobilization of equipment, plant, tools, material and key staffs	LS	1		
1.3	Demobilization of equipment, plant, tools, material and key staffs	LS	1		
1.4	Establishment of temporary camp with one permanent room to be used by consultant and provision of office facilities.	LS	1		
1.5	Reporting and Progress Reports	LS	1		
1.6	Preliminary Item to provide for Sign Boards and compliance with the conditions of contract and specification	LS	1		
			Total for Bill No. 1		_____

Bill No. 2: Earthworks and Linings

Item no.	*Description*	*Unit*	*Quantity*	*Rate (TZS)*	*Amount (TZS)*
2.1	**Earthworks and Linings**				
2.1.1	Striping of topsoil to an average depth not exceeding 0.3m at embankment and dam areas including removing roots, load and haul to a distance of not more than 1,000 meters away or as directed by the Supervising Engineer	m^2	10,100		
2.1.2	Blasting of hard rock materials	m^3	9,400		
2.1.3	Excavation of highly weathered rock/soft rock/mixtures of sand, clay, gravels and cobbles at a TSF footprint area	m^3			
2.1.4	Supply rocks /soils for constructing an earthfill embankment excavated from the TSF footprint, **filling, spreading, watering** and **compact** in lifts of 300 mm **to achieve 95% MDD BS Heavy** and 4 days soaked CBR of at least 15	m^3	10,360		
2.1.5	Supply and lay of stone pitching on the downstream face up to a top level of the embankments	m^2	3,040		
2.2	**Linings**				
2.2.1	Supply and compact to achieve 300mm thick clay soils in lining a bottom and upstream side of the TSF embankment	m^3	2,140		
2.2.2	Supply and install 1.5mm thick HDPE liner throughout the TSF	m^2	7,150		
			Total for Bill No. 2		_____

Bill No. 3: Ancillary Facilities

Item no.	*Description*	*Unit*	*Quantity*	*Rate (TZS)*	*Amount (TZS)*
3	**Ancillary works**				
3.1	Supply and install a 1200 mm diameter decant tower, precast concrete slotted pipe surrounded by washed gravels with d50% around 2 – 3 mm in turn surrounded by clean rockfill with d50% up to 40mm.	No.	1		
3.2	Supply and install 300mm HDPE PN 25/Concrete/Cast iron drainage pipe from a decant tower to a wastewater return pond or as directed by the Supervising Engineer.	m	100		
3.3	Supply and install discharge line pipes with associated spigots and other fittings	LS	1		
3.4	Supply and construct a decant pond access embankment earthworks compacted in lifts of maximum of 0.3m height or as directed by the Supervising Engineer.	m^3	800		
3.5	Quality control tests	LS	1		
3.6	Drilling and instrumentation of two 200mm diameter GW monitoring boreholes in the downstream and upstream of the main embankment to monitor groundwater levels and groundwater quality each to a maximum depth of 70m. *The rate should include the rate of drilling, casing, instrumentation, supply and installation of 2 submersible pumps (Q = 5m³/hr at a head of 100m) and all*	m	140		

	associated fittings for the fully operational of the intended purposes.				
3.7	Excavated and construct the concrete drainage ditch, C20, reinforced with BRC, 1m deep with side slopes of 1:2 around the TSF or as directed by the Supervising Engineer.	m^3	200		
3.8	Excavate a return water pond of $300m^2$ to a minimum depth of 1.5m with side slopes of 1:1.5 and line throughout with liners as per specification used in lining the TSF	No.	1		
3.9	Provide, install and commission a return water pond pump as to be detailed by the client or project engineer [Pump minimum capacity of 20 m^3 / day for a head of 50m]	No	1		
			Total for Bill No. 3		_____

Appendix XI: Geotechnical Site Investigation

THE UNITED REPUBLIC OF TANZANIA

PROPOSED CONSTRUCTION AND OPERATION OF THE CIP PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION

PROPOSED DESIGN AND CONSTRUCTION OF TAILINGS STORAGE FACILITY

FINAL REPORT

GEOTECHNICAL SITE INVESTIGATION

Submitted by

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16th April 2024

EXECUTIVE SUMMARY

The Government of the United Republic of Tanzania (URT) has received funds from the World Bank (WB) Global Environmental Facility (GEF) to undertake The Environmental Health and Pollution Management Project (EHPMP). The EHPMP is five years (July 2020–July 2025) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana which aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries. In response, the URT government, through EHPMP intends to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region for which it has mandated University of Dar es salaam to develop a Carbon In Pulp (CIP) Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region.

To allow for detailed design of the proposed TSF and foundations for other related civil engineering infrastructures at the site and in partial fulfilment of the documentation necessary for application of relevant building permits, the hereby reported geotechnical engineering site investigation services were commissioned at the proposed project site.

The objective of the commissioned geotechnical site investigation is to undertake and report on a ground investigation that estimates the civil geotechnical engineering properties of the grounds at the project site such that the ground stability / bearing capacity, permeability as well as the ground–structure interaction settlements can be predicted. In–line with this objective, three (3) boreholes, 1 trial pit were drilled/excavated at a varying depth to a maximum depth of 10.0 m below the original ground levels (o.g.l), Additionally, two potential sources of clay soils for the design of an impervious clay liner for Tailing Storage Facility (TSF) were obtained near the TSF site.

Geotechnical site investigations typically comprise a desk study; walk–over reconnaissance site survey; intrusive field ground investigation; soils, water, or rock laboratory testing; results analysis and finally factual or interpretative reporting.

Bumva - Segese local geology description by the geological map of Bukombe Quarter Degree Sheet 62 from the Geological Survey of Tanzania suggests the project area consists of very thin sandy soil layer overlying a diorite,

coarse grained equigrannular gray derived from granite through the crystallization of magma within the Earth's crust rich in plagioclase, clinopyroxene, hornblende and apatite minerals. On the southern part of the site, the geology of the site consists of green stone. Mafic to felsic and banded iron formations with one line interpreted as a fault. The site consists of the rock of non-uniform thickness overlying a clayey sandy gravel layer.
All samples collected during the field ground investigation were carefully handled on site and submitted to the University of Dar es Salaam (UDSM) Soil mechanics and Construction Materials Laboratories for further characterisation. Results of tests performed on SPT split-spoon as well as disturbed/ remoulded / bulk soil or rock samples are attached herein.
The report ends with foundations design considerations, conclusions and recommendations.

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Acronyms and abbreviations

a.m.s.l	-	above mean sea level
ASGM	-	Artisanal Small Scale Gold Miners
ASTM	-	American Society for Testing and Materials
b.g.l	-	below ground level
CIP	-	Carbon In Pulp
CBR	-	California Bearing Ratio
EHPMP	-	Environmental Health and Pollution Management Project
FoS	-	Factor of Safety
GEF	-	Global Environmental Facility
GST	-	Geological Survey of Tanzania
K_a	-	Ground acceleration factor
LL	-	Liquid Limit
MDD	-	Maximum Dry Density
PGA	-	Peak Ground Acceleration
PID	-	Point Identification
PL	-	Plastic Limit
PQ	-	Performance qualifiers
SA	-	Spectral Accelerations
SPT	-	Standard Penetration Test
TSF	-	Tailing Storage Facility
UDSM	-	University of Dar es Salaam
URT	-	United Republic of Tanzania
UTM	-	Universal Transverse Mercator
WB	-	World Bank
WGS	-	The World Geodetic System

1.0 Project Description

The Government of the United Republic of Tanzania (URT) has received funds from the World Bank (WB) Global Environmental Facility (GEF) to undertake The Environmental Health and Pollution Management Project (EHPMP). The EHPMP is five years (July 2020–July 2025) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana which aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries. ASGM uses mercury in gold recovery in a manner that is dangerous to human health and the environment because amalgamation is done with bare hands and the amalgam is heated in open air to drive away the mercury. Furthermore, in ASGM for every 1 kg of gold recovered, about 2 kg of mercury is used and most of it is released into the environment. In response, the URT government, through EHPMP intends to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region for which it has mandated University of Dar es salaam (UDSM) to develop a Carbon In Pulp (CIP) Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region. Amongst the structures planned at the centre is a Tailings Storage Facility (TSF) (Appendix I - Figure 1) that will allow for safe, optimum and sustainable handling of all tailings from the gold processing.

To allow for detailed design of the proposed TSF and foundations for other related civil engineering infrastructures at the site and in partial fulfilment of the documentation necessary for application of relevant building permits, the hereby reported geotechnical engineering site investigation services were commissioned at the proposed project site.

2.0 Objective and Scope

The objective of the commissioned geotechnical site investigation is to undertake and report on a ground investigation that estimates the civil geotechnical engineering properties of the grounds at the project site such that the ground stability / bearing capacity, permeability as well as the ground–structure interaction settlements can be predicted.

In–line with this objective, three (3) boreholes were drilled to a maximum depth of 10.0 m below the original ground levels (o.g.l), one (1) trial pit was manually excavated to shallow depths at the site and two potential sources of clay soils for the design of an impervious clay liner for the TSF were sampled as indicated on Table 1 and Appendix I - Figure 2. A bulk sample from a trial pit was extracted to evaluate its appropriateness as a local borrow material for constructing the embankment wall of the TSF.

Table 1: Summary details of geotechnical site investigation sampling at the site for the proposed Tailing Storage Facility (TSF) for ASGM at Bumva, Msalala, Shinyanga, Tanzania

PID	WGS 1984 UTM COORDINATES		ELEVATION (m)	Depth (m)
	EASTINGS (mE)	NORTHINGS (mS)		
BH 01	440012.85	9609552.28	1253.70	10
BH 02	439971.00	9609615.51	1249.12	6
BH 03	440028.38	9609601.40	1250.52	10
TP 01	440044.00	9609631.00	1249.15	1.75
BP 01	440061.21	9609426.81	1264.50	0.5
BP 02	440116.75	9609386.25	1266.13	0.5

3.0 Investigation Methodology

Geotechnical site investigations typically comprise a desk study; walk-over reconnaissance site survey; intrusive field ground investigation; soils, water, or rock laboratory testing; results analysis and finally factual or interpretative reporting.

In the desk study all information related to the project is collected and relevantly reviewed. The site reconnaissance entails performing a physical walkover survey of the site being investigated. By this then an aptly trained Geotechnical Engineer visits the site and identifies surface features visible to an unaided eye which are deemed of importance to the performance of the proposed engineering use intended for the project site. At this investigative stage relevant local knowledge is also sourced by conversing with informed locals. After these two, a ground investigation is appropriately catered to the outcomes obtained so far as well as to the proposed engineering use.

Field ground investigation necessitates intrusion of the ground by opening-up test pits or advancing boreholes depending on the suggested depths of investigation and doing appropriate sampling and characterization of the encountered ground strata as on each relevant depth. Characterization of the encountered ground strata is done jointly, on site and by appropriate laboratory testing. Laboratory results with the in-situ field tests are then analysed and interpretations are done based on the expected soil mechanical behaviour and assumed interaction with any of the proposed engineering uses.

Boreholes are drilled by heavy duty manual augering or machine rotary coring through the ground. In this technique an auger or core barrel is advanced into the ground while being rotated to various depth strokes followed by withdrawal and emptying of the soil cuttings retrieved. These are then field classified and arranged in a core box or on the lined ground in a line sequence as in the order they were exhumed to define the ground profile. Water is added in the borehole momentarily to ease drilling as necessary and during Standard Penetration Testing (SPT) the boreholes are typically supposed to be filled with water or drilling mud to ground level.

During the drilling activities at the Bumva site, the groundwater table was not encountered. Bulk disturbed samples or rocks were taken from every different stratum layer encountered along the borehole profile as well as using the 50-mm diameter split spoon sampler slightly disturbed samples in conjunction with SPT were done.

In-situ SPT is done at 1.5 depth intervals down the borehole. SPT sampler used is in accordance with ASTM D1586-64T which involves driving a standard split spoon sampler tool through 450-mm at the specified depth of the borehole using an automatic trip hammer weighing 63.5 kg with a falling height of 760mm. The blows required to drive the sampler through the first 150mm are the seating drive as this soil thickness is assumed to be disturbed and the number of blows are taken as indicative only. The number of blows required to drive the sampler through the last 300mm are recorded as SPT "N-value", counted in 150mm increments to reflect continuity. The sampler is tied to a system of 1.5m long or 3m long "N" rods of round cross-section to the desired testing depth. Furthermore, a core cutter sampler was utilized to core and extract rock samples, employing PQ diamond bits for the coring process. The samplers used during the sampling process were equipped with smooth surfaces, suitable area ratios, and cutting-edge angles to reduce rock disturbance to a minimum.

4.0 Site Geology

Bumva - Segese local geology description by the geological map of Bukombe Quarter Degree Sheet 62 from the Geological Survey of Tanzania suggests the project area (Appendix II - Figure 3) consists of sandy soil overlying a diorite, coarse grained equi-grannular gray derived from granite through the crystallization of magma within the earth crust rich in plagioclase, clinopyroxene, hornblende and apatite minerals. On the southern part of the site, the geology of the site consists of green stone. Mafic to felsic and banded iron formations with one line interpreted as a fault.

5.0 Site Seismic Category

As per various reviewed map sources and other relevant literatures, the Shinyanga area, and therefore the proposed project site, is generally categorised in the regional seismic risk map from the Tanzania Technical Guideline of Loads for Structural Design as Zone 2 with non–violent, moderately frequently seismic hazard potential of 5 – 6 on the Richter scale with a ground acceleration factor, k_a of 0.050 as shown in Appendix III - Figure 4. Msabi and Ferdinand (2021) conducted a study to assess the seismic hazard levels in the Northern Tanzania regions, including Shinyanga Region by using an earthquake catalogue from 1956 to 2011. The study involved computing Peak Ground Accelerations (PGA) and Spectral Accelerations (SA) at 0.2 seconds and 2.0 seconds for a 10% probability of exceedance over 50 years and a return period of 475 years at 5% damping. The findings revealed PGAs ranging from 1 to 6.5 m/s^2 at 0.2 seconds and from 0.06 to 0.27 m/s^2 at 2 seconds. This categorization further indicates that the seismic hazards in the area are not violent and moderately frequent.

6.0 Site Weather

Appendix IV incorporates site weather information that summarises weather data from 2000 to 2022 with the data being presented as monthly averages over 22 years (NASA, 2023).

7.0 Site ground profile

Appendix V presents the logs and images of ground profiles from the boreholes and trial pit done on site and other relevant features observed around the site. The ground profile at the site consists of variable soils averaging at *a disconnected porous rock intact to weathered rock reddish brown from the ground surface extending to an average depth of 4 ± 2 m. Beneath the rock layer, the encountered soils exhibit an average dense to very dense reddish brown silty sandy clayey gravel of low to high plasticity.* Drilling was terminated where the very dense strata or rock extend continuously to a depth of 6.0 m as depicted in the Appendix V . Using the Rock Quality Designation (RQD) to classify rock mass quality, the average RQD at an average depth of 4 ± 2 m below ground level is 75%, signifying a fair quality of rock mass (Deere, 1988). In-situ Standard Penetration Test (SPT) was carried out at every point (depth) where soil was encountered.

8.0 Laboratory Testing

All samples collected during the field ground investigation were carefully handled on site and submitted to the University of Dar es Salaam (UDSM) Construction Materials Laboratories for further characterisation. Appendix VI summarises classification, density, moisture state, shear strength, permeability, compressibility, unconfined compressive strength, compaction and California Bearing Ratio tests results from SPT split-spoon as well as disturbed/ remoulded / bulk soil or rock samples.

The Unconfined Compressive Strength test was carried out on rock samples obtained at a depth of 4 ± 2 m averaging to a dry unit weight of 22± 2 kN/m^3. The results indicated an average value of 10 MPa from the ground surface to a depth of 2.0 m, signifying fairly weak rock and 2.8 MPa below the depth of 2.0 m indicating a weak rock.

The site ground profile below the rock averagely classifies as *dense to very dense* clayey (13%) silty (17%) sandy (20%) *Gravel* (50%) of low to high plasticity averaging at LL = 42 ± 8%, PI = 25 ± 5%.

The ground bulk unit weight was assessed as 19.0 ± 1.50 kN/m^3, the natural moisture content as 14 ± 3.6% and the dry unit weight as 16.6 ± 3.60 kN/m^3.

The permeability of the rock and soil sample was also assessed and the permeability of the rock was determined based on BS EN 12390 -8 (water permeability test) and was found to be $1.04 \times 10^{-7} \mathrm{m/s}$ signifying average permeability as per category set by BS EN 12390 – 8. The minimum permeability of the soil was assessed as $4.78 \times 10^{-8} m/s$ and maximum as

$5.67 \times 10^{-5} m/s$ averaging at $1.63 \times 10^{-5} m/s$ signifying good drainage hence potential for seepage losses.

The soil strength parameters, internal angle of friction and cohesion, of the soils beneath the rock was found averaging to 25.3 ± 1.0 degrees and 28 ± 2 kPa respectively.

Compaction and three-point CBR tests were performed on bulk samples to assess the suitability of the soil for constructing a clay liner aiming to control seepage in an earth fill embankment. The CBR value averaged to 3 at 95% of the maximum dry density (MDD). The profile of the potential source of clay as a liner averagely classifies as gravelly (2%) clayey (20%) sandy (21%) Silt (57%) of high plasticity averaging at LL = 51.5 ± 0.5%, PI = 29.0 ± 1%. The average permeability was found to be $6.60 \times 10^{-8} m/s$ signifying poor to practically impervious drainage showing potential to be used as a liner.

9.0 Design considerations

With reference to the scoping report prepared by School of Mines and Geosciences, University of Dar es Salaam, Tailings from the CIP plant will be pumped to a small tailings storage facility (TSF) with storage capacity of 2000 m^3 and embankment inner dimensions of 35 m x 35 m and height 1.8 m having the crest width ranging from 1.5 m to 2.0 m. Construction of the TSF will start by stripping the topsoil and levelling, followed by compacting clay soil as liner to control seepages. TSF embankments will be constructed at slopes of 1:2 and 1:3 for upstream and downstream edges respectively. Saprolyte and clay materials available onsite will be used for construction of embankments. Upstream phase of embankment will be lined with compacted clay. In order to control seepages from the inside of the TSF and erosion of the outer slopes of the embankments, HDPE liner of 1.5 mm thick will be used. Tailings discharge into the facility will be done through spigots on the inner embankment perimeter.

The allowable bearing capacity (FoS = 3.0) for shallow foundations can be estimated from the laboratory test results of the clayey sandy silty gravel of low to high plasticity encountered using an average characteristic cohesion (C′ ≈ 28 kPa), internal angle of soil friction (ø′= 25°) with Brinch Hansen's bearing capacity formula resulting to allowable bearing capacity from 320 kPa and higher.

Expected settlements are to be estimated from the reported laboratory testing stiffness values and they will depend on the applied foundation stresses implicitly restricted to 25 mm. Differential settlements will be minimized by founding the embankment wall at the same level, on same soil strata and with the maximum allowable bearing capacity requirements. It can also be reasonably assumed that minimum moisture variations can be expected with depth and therefore minimized differential settlements when the foundations are put at depth.

The average in-situ permeability of the ground profile was assessed in the laboratory as $1.04 \times 10^{-7} m/s$ signifying average permeability as per category set by BS EN 12390 – 8 and the average insitu permeability of the soil was found to be $1.63 \times 10^{-5} m/s$ at the in-situ average bulk unit weight of 19 kN/m^3 signifying good drainage as typical of mixtures of fine to very fine sand, silt, sand, clay and gravel mixtures hence potential for seepage losses.

10.0 Conclusions and recommendations

The following conclusions and recommendations emanate from the geotechnical site investigation at the site for the proposed design of tailings storage facility (TSF) at CIP Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region, Tanzania;

1. The site consists of the rock of non-uniform thickness overlying a clayey sandy gravel layer. The on-site findings align with the geological conditions, indicating a historical volcanic eruption in the area that covered the pre-existing terrain, resulting in the deposition of re-sedimented and sedimented volcaniclastic material over the existing ground, leading to the formation of alternating layers of rocks and soils across the region (Stiefenhofer and Farrow, 2004).

2. The Unconfined Compressive Strength (UCS) on rock samples obtained at a depth of 4 ± 2 m averaging to a dry unit weight of 22 ± 2 kN/m^3 resulted to an average value of 10 MPa from the ground surface to a depth of 2.0 m, signifying fairly weak rock and 2.8 MPa below the depth of 2.0m indicating a weak rock.

3. The site ground profile below the rock averagely classifies as dense to very dense clayey (13%) Silty (17%) sandy (20%) Gravels (50%) of low to high plasticity averaging at LL = 42 ± 8%, PI = 25 ± 5%.

4. Based on the assessment of the terrain and geotechnical properties of the site for the proposed TSF, and a trapezoidal embankment earth dam wall with varying crest height above original ground levels around the TSF perimeter is to be employed for a tailings storage capacity of 2000 cubic meters which is to last a design life of 20 years before the subsequent lift based on the scoping report prepared by the school of mines and Geosciences, University of Dar es salaam. The crest height in the northern side of the site will be set at 1.8 m, while in other sides, the crest elevation will be determined based on the excavation needed to achieve the level at the bottom of the Tailing Storage Facility (TSF) to meet the specified capacity.

5. The embankment wall foundation depth is to be considered at 1.5m below original ground levels on site as at this depth there are same soil strata (rock) to receive foundations and less susceptible to scour effects upon exposure however the soil layer beneath the rock governs the foundation design because of its lower strength than the overlying rock.

6. The allowable bearing capacity (FoS = 3.0) for shallow foundations can be estimated from the laboratory test results of the clayey sandy silty gravel of low to high plasticity encountered using an average characteristic cohesion (C′ ≈ 28 kPa), internal angle of soil friction (Ø′= 25°) with Brinch Hansen's bearing capacity formula resulting to allowable bearing capacity from 320 kPa and higher.

7. The CBR value on the bulk samples collected from possible sources of clays averaged to 3 at 95% of the maximum dry density (MDD). The profile of the potential source of clay as a liner averagely classifies as gravelly (2%) clayey (20%) sandy (21%) Silt (57%) of high plasticity averaging at LL = 51.5 ± 0.5 %, PI = 29.0 ± 1 %. The average

permeability was found to be $6.60 \times 10^{-8} m/s$ signifying poor to practically impervious drainage saving potential as a liner.

8. Expected settlements are to be estimated from the reported laboratory testing stiffness values and they will depend on the applied foundation stresses implicitly restricted to 25 mm. Differential settlements will be minimized by founding the embankment wall at the same level, on same soil strata and with the maximum allowable bearing capacity requirements. It can also be reasonably assumed that minimum moisture variations can be expected with depth and therefore minimized differential settlements when the foundations are put at depth.

9. The permeability of the rock and soil sample was also assessed and the permeability of the rock was determined based on BS EN 12390 -8 (water permeability test) and was found to be $1.04 \times 10^{-7} m/s$ signifying average permeability as per category set by BS EN 12390 – 8. The minimum permeability of the soil was assessed as $4.78 \times 10^{-8} m/s$ and maximum as $5.67 \times 10^{-5} m/s$ averaging at $1.63 \times 10^{-5} m/s$ signifying good drainage hence potential for seepage losses.

11.0 References

11.1 Building Research Unit (BRU) (currently National Housing Building Research Agency, NHBRA). Technical Guideline No. 2: Loads for Structural Design, pp, 27.

11.2 Deere, D. 1988. The rock quality designation (RQD) index in practice. Rock classification systems for engineering purposes. ASTM International.

11.3 Geological Survey of Tanzania (GST) 1967. Geological Map of Bukombe Quarter Degree Sheet 62.

11.4 Google Earth © 2024 accessed January 2024.

11.5 Msabi, M. M. & Ferdinand, R. 2021. Probabilistic seismic hazard analysis for Northern Tanzania Divergence Region and the adjoining areas. Tanzania Journal of Science, 47, 862-876.

11.6 NASA. 2023. Prediction of Worldwide Energy Resource (POWER) and Agroclimatology Community [Online]. Available: https://power.larc.nasa.gov/data-access-viewer/ [Accessed 05th January 2024].

11.7 Stiefenhofer, J. & Farrow, D. J. L. 2004. Geology of the Mwadui kimberlite, Shinyanga district, Tanzania. 76, 139-160.

12.0 Appendix I – Site location

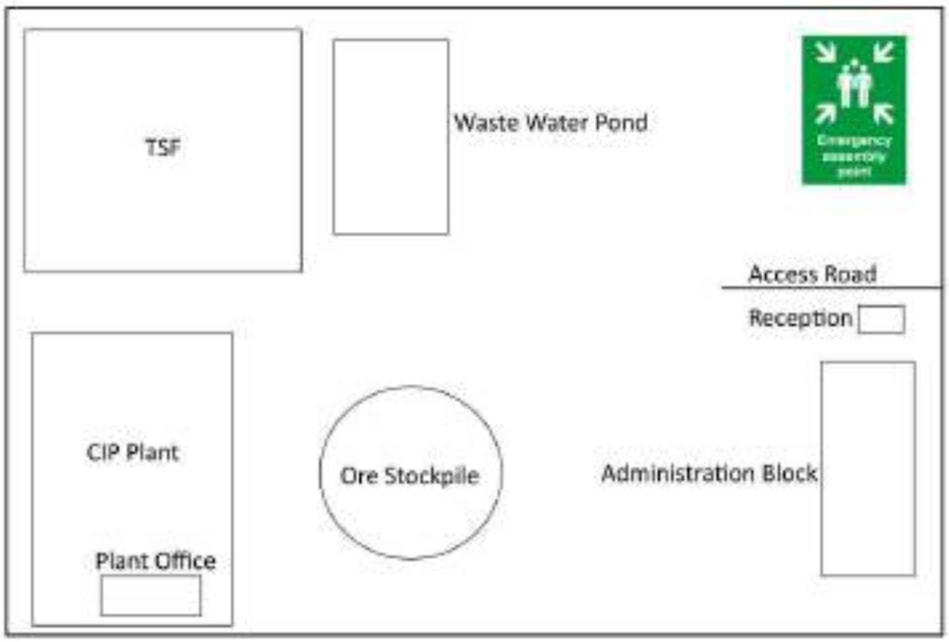

Figure 1: Schematic layout of the proposed Artisanal and Small-scale Gold Mining mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region

Figure 2: Google earth image showing the site of the proposed design of Tailings Storage Facility (TSF) at Bumva, Segese, Msalala, Tanzania with the relative locations of geotechnical investigation points and possible sources of soils for embarkment clay lining.

13.0 Appendix II – Site Geology

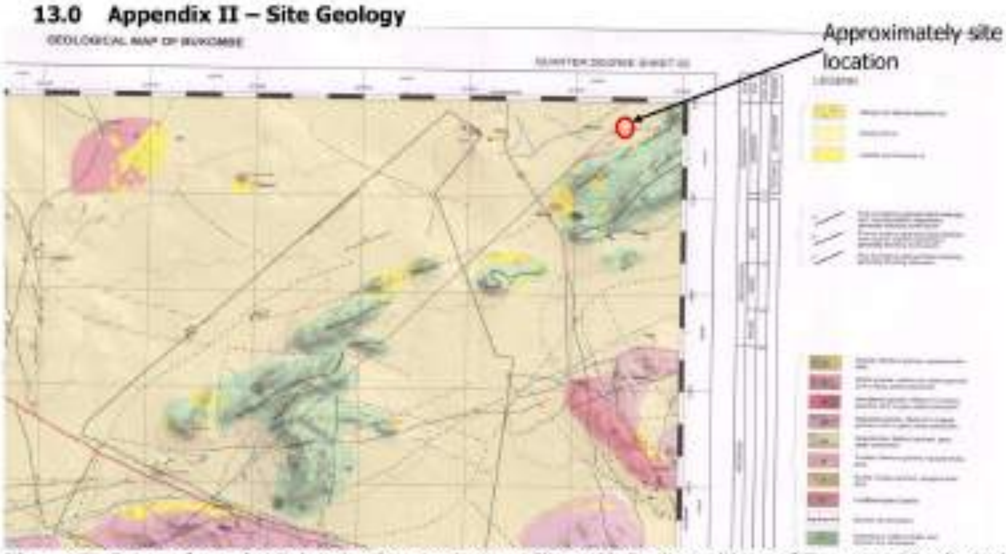

Figure 3: Extract from the Bukombe Quarter Degree Sheet 62 Geological Map of Tanzania (Geological Survey of Tanzania (GST), 1967)

14.0 Appendix III – Seismic hazards map of Tanzania

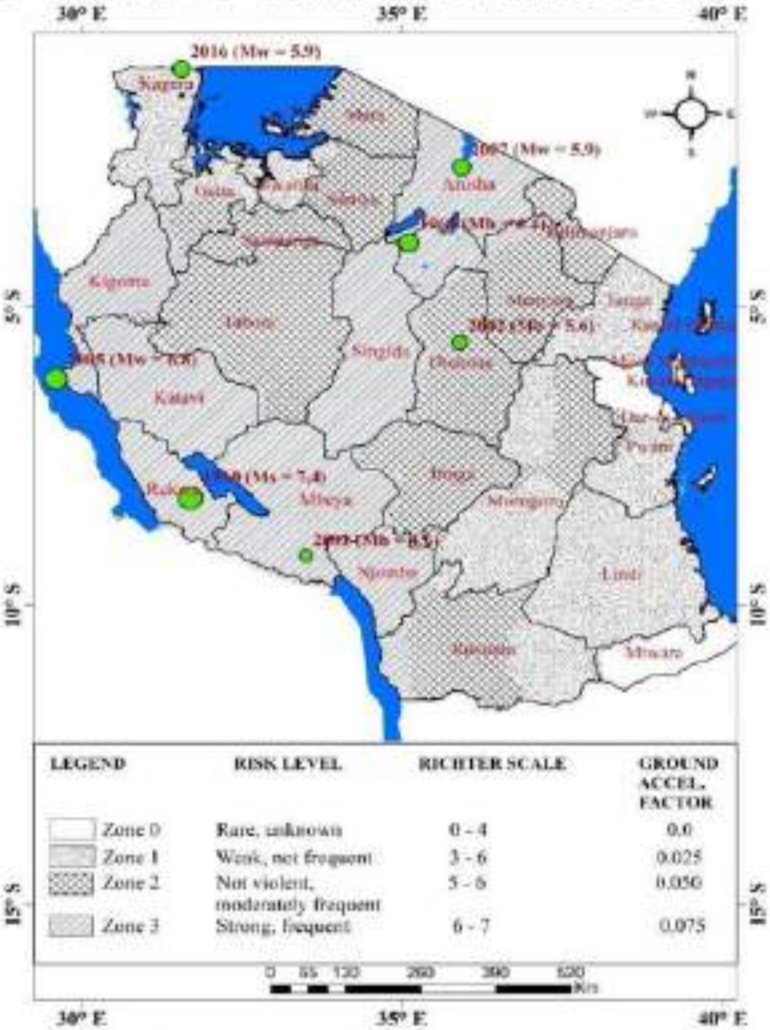

Figure 4: Earthquake Distribution for construction building code in Tanzania (Modified after NHBRU Technical Guideline No. 2 (Second Edition)) (Msabi and Ferdinand, 2021)

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15.0 Appendix IV - Site weather

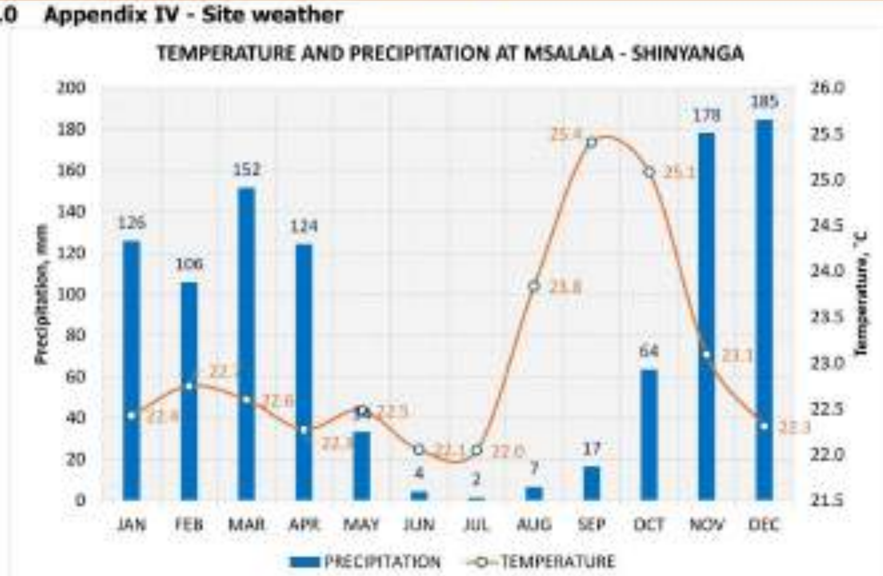

Figure 5: Average monthly temperature and precipitation from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

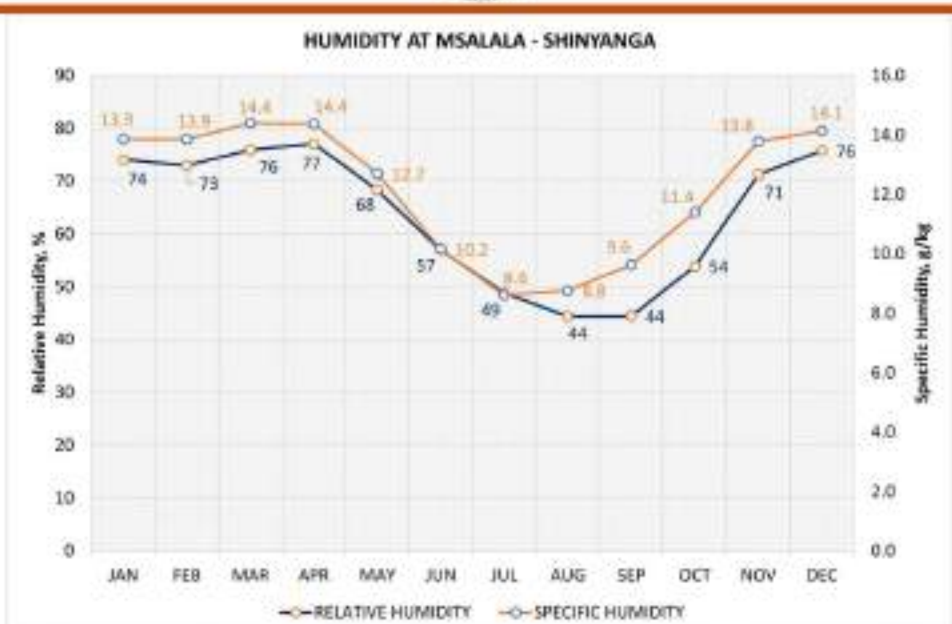

Figure 6: Average monthly relative and specific humidity from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

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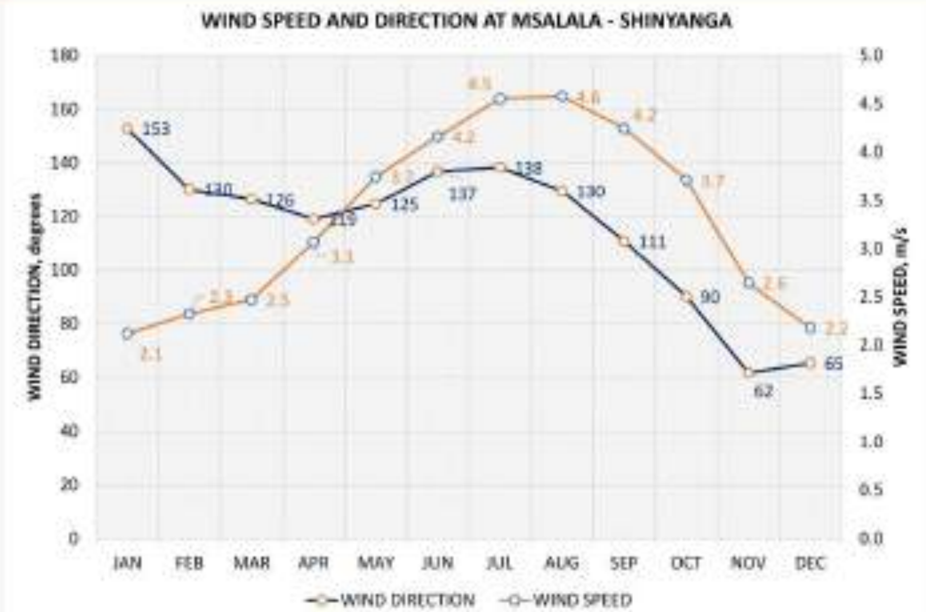

Figure 7: Average monthly wind direction and wind pressure from 2000 to 2022 at Msalala, Shinyanga, Tanzania.

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16.0 Appendix V – Ground Profiles

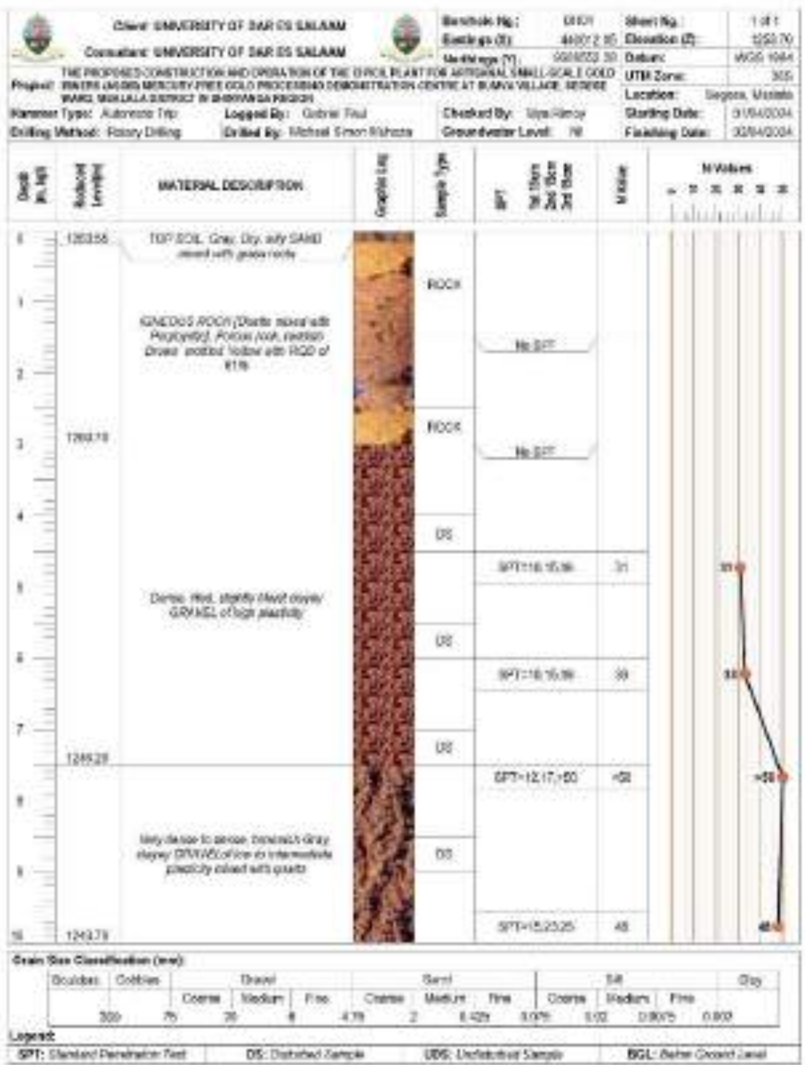

Figure 8: Borehole log of BH01

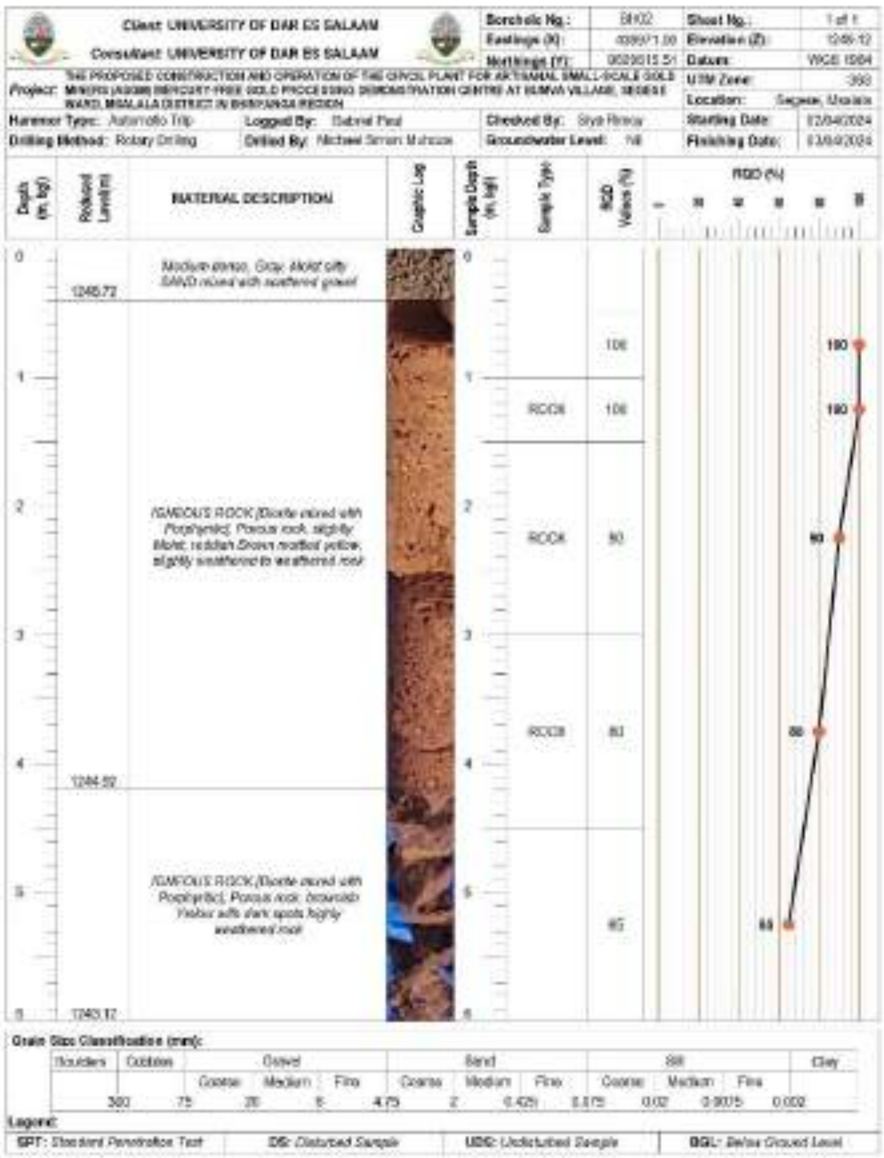

Figure 9: Borehole log of BH02

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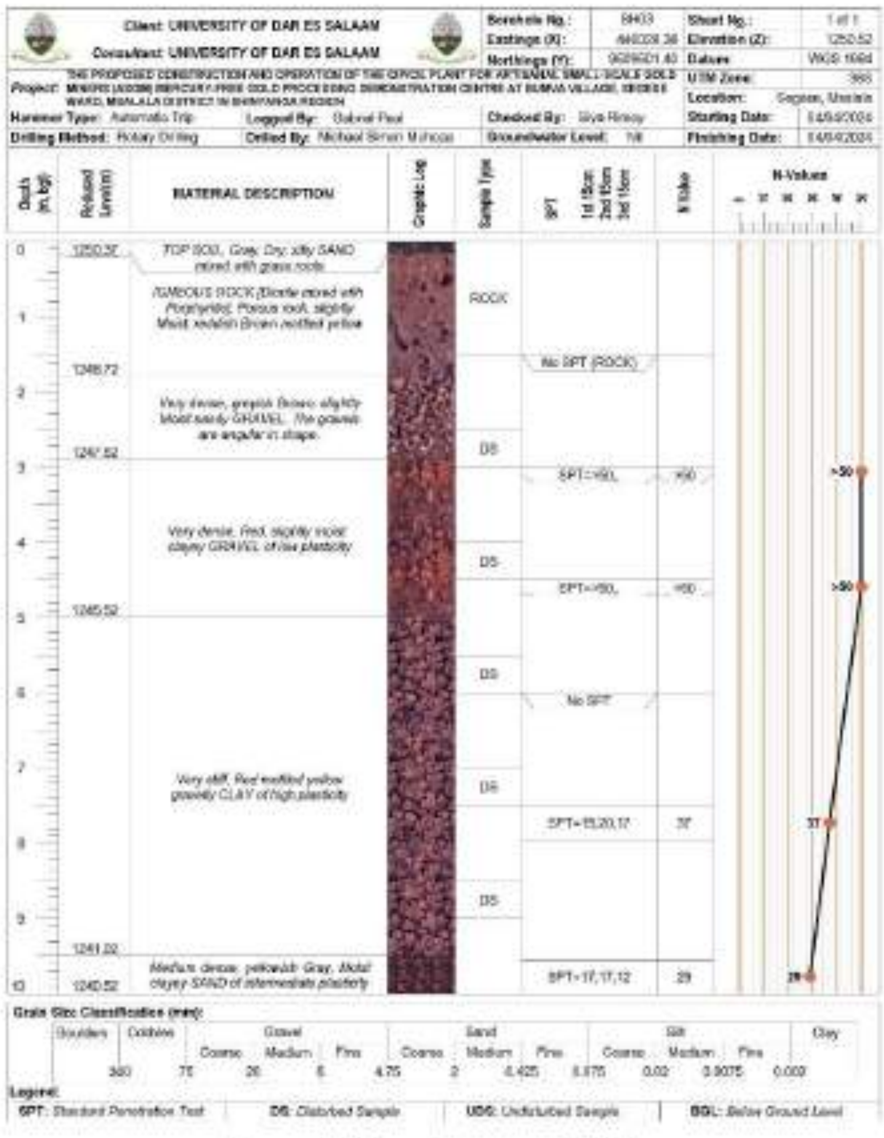

Figure 10: Borehole log of BH03

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Client: UNIVERSITY OF DAR ES SALAAM	Trial Pit No.:	TP01	Sheet No.:	1 of 1
Consultant: UNIVERSITY OF DAR ES SALAAM	Eastings (X):	440044.00	Elevation (Z):	1248.11
	Northings (Y):	9609031.00	Datum:	WGS 1984
Project: THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIVCS PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION			UTM Zone:	36S
			Site Location:	Segese, Msalala
Hammer Type: Nil	Logged By: Gabriel Paul	Checked By: Siya Rimoy	Starting Date:	04/04/2024
Drilling Method: Manual Excavation	Drilled By: Michael Simon Mahona	Groundwater Level: Nil	Finishing Date:	05/04/2024

Depth (m, bgl)	Reduced Level (m)	MATERIAL DESCRIPTION	Graphic Log	Thickness (m)	Sample Type	TRIAL PIT PROFILE
0 – 0.25	1248.81	TOP SOIL, Moist, Dense, Gray, silty GRAVEL, mixed with grass roots		0.3		
0.25 – 1.75		Moist, Dense, reddish Brown, clayey GRAVEL of intermediate plasticity		1.45	BULK	

Grain Size Classification (mm):

Boulders	Cobbles	Gravel			Sand			Silt			Clay
		Coarse	Medium	Fine	Coarse	Medium	Fine	Coarse	Medium	Fine	
300	75	20	6	4.75	2	0.425	0.075	0.02	0.0075	0.002	

Legend:

SPT: Standard Penetration Test | DS: Disturbed Sample | UDS: Undisturbed Sample | BGL: Below Ground Level

Figure 11: Borehole log of TP01

Geotechnical Site Investigation Draft Final Report for TSF at Segese in Shinyanga 29

Figure 12: Image of ground profile from borehole BH01

Figure 13: Image of ground profile from borehole BH02

Figure 14: Image of ground profile from borehole BH03

Figure 15: Image of ground profile from Trial pit, TP01

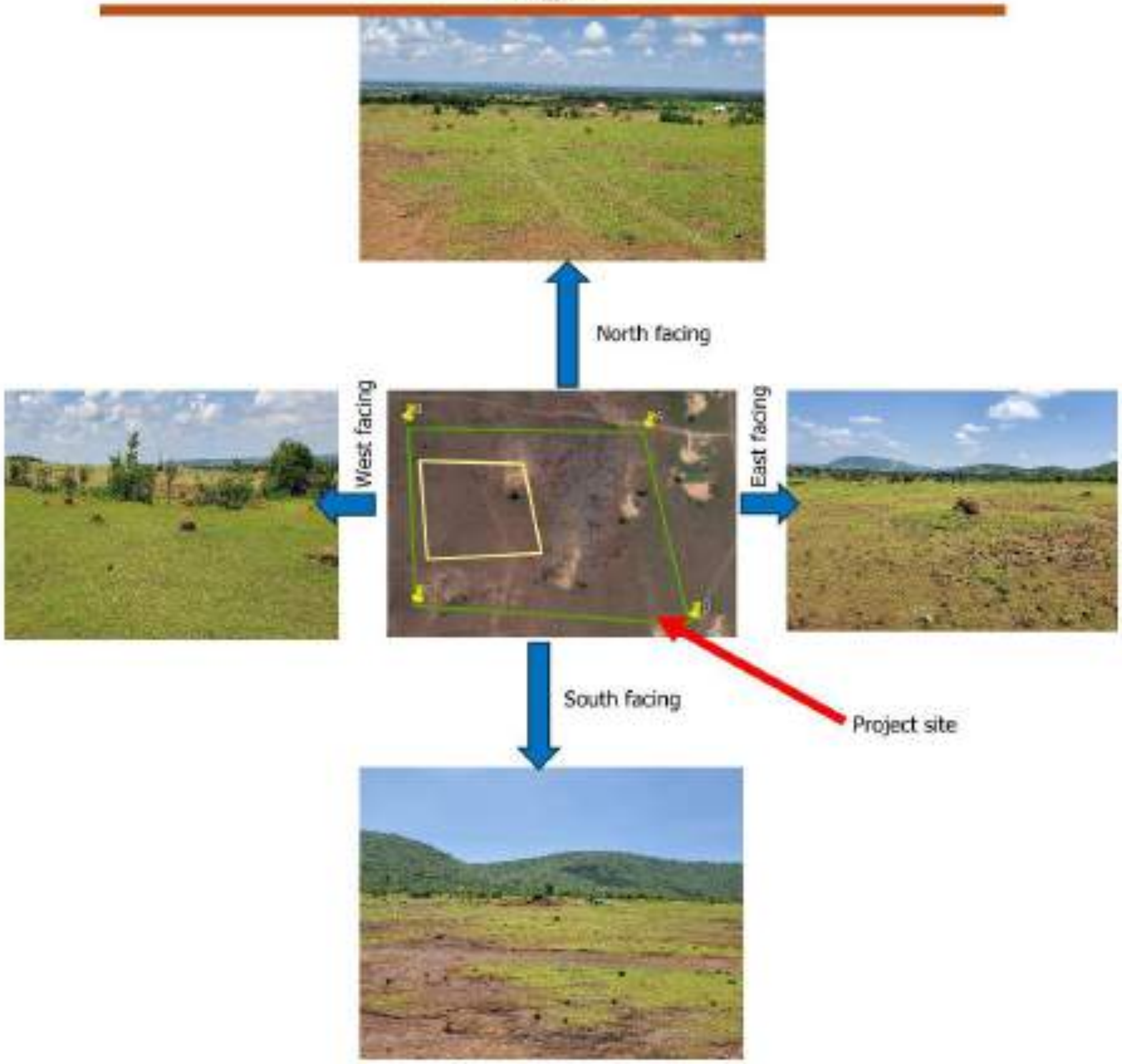


Figure 16: Image of different facings of the project site

Table 2: Bearing capacity estimations by Brinch Hansen formula.

Design of shallow foundation (Brinch Hansen equation) (Hansen,1970)

$$q_{ult} = C'N_cS_cd_ci_cf_cg_c + \sigma'_vN_qS_qd_qi_qf_qg_q + 0.5B_\gamma N_\gamma S_\gamma d_\gamma i_\gamma f_\gamma g_\gamma$$

i is the load inclination factor, load is vertical, i=1.0

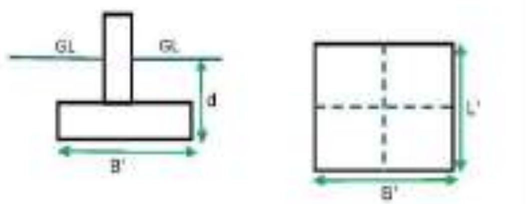
f=foundation inclination, foundation is level, f=1.0

g=ground inclination factor, ground is level, g=1.0

d=depth factor, d<B, then d=1.0

$$q_{ult} = C'N_cS_c + \sigma'_vN_qS_q + 0.5B_\gamma N_\gamma S_\gamma$$

Input parameters	Value	Unit
Foundation depth,d	1.5	m
GWT depth, dw	0.0	m
γ_{sat} overburden	19.0	kN/m³
γ_{sat} foundation	19.0	kN/m³
γ_w	9.8	kN/m³
Cohesion, C'	28.0	kPa
Internal angle of friction, ø'	25.0	°
Factor of Safety,FOS	3.0	



	Foundation Sizes					
	Pad foundation , assumed square					
Derived Parameters	L' = 5m B' = 5m	L' = 10m B' = 10m	L' = 20m B' = 20m	L' = 30m B' = 30m	L' = 35m B' = 35m	L' = 40m B' = 40m
Bearing capacity factors (N),Mayerhof(1963)						
N_q	10.66	10.66	10.66	10.66	10.66	10.66
N_c	20.72	20.72	20.72	20.72	20.72	20.72
N_γ	6.77	6.77	6.77	6.77	6.77	6.77
Shape factors Skempton (1952)						
S_q	1.70	1.70	1.70	1.70	1.70	1.70
S_c	1.20	1.20	1.20	1.20	1.20	1.20
S_γ	0.90	0.90	0.90	0.90	0.90	0.90
Foundation depth factors, Hansen (1970)						
d_q	1	1	1	1	1	1
d_c	1	1	1	1	1	1
d_γ	1	1	1	1	1	1
q_{ult} **(kPa) for concentric vertical loading**	961	976	1007	1037	1053	1068
$q_{allowable}$ (kPa) for concentric vertical loading	**320**	**325**	**336**	**346**	**351**	**356**

17.0 Appendix VI – Laboratory test results

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College of Engineering and Technology
Department of Transportation and Geotechnical Engineering
Soil Mechanics Laboratory

KEY TO SYMBOLS
To column 3: uds = undisturbed d = disturbed Spt = Standard penetration test C = core sample O = organic Pt = peat A1 = Area 1
To column 5: G = gravel S = sand M = silt C = Clay P = poorly graded L = low plasticity H = high plasticity I = Intermediate Plasticity V = Very high plasticity E = Extremely high plasticity

COMPILATION OF MECHANICAL COEFFICIENTS

CLIENT: STATE MINING CORPORATION(STAMICO)
PROJECT: THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION
CONSULTANT: UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY
Operator: B.Eshiwakwe Checked: Lugano Approved: F.Masfiri Date: 13/03/2024

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		20	21		22
			British Soil Classification System		Particle size distribution				Densities				Consistency			Free Swell	Swell Pressure	Direct shear		Permeability	Triaxial shear (CU)		Oedometer
BH ID	Sample Depth (m)	Sample type	Description	Group Symbol	Clay 0.002 mm	Silt 0.002 to 0.063 mm	Sand 0.063 to 2.0 mm	Gravel 2.0 to 63 mm	Bulk Density	Dry density	Density of solids	Natural water content	Liquid Limit	Plastic Limit	Plasticity Index	%		Friction angle	Cohesion	Coefficient of permeability	Friction angle	Cohesion	Mv
Symbols									ρ	ρd	ρs	Wn	LL	PL	I_p		-	Φ	C	K-Value	φ'	C'	E_c
Units					%	%	%	%	Mg/m³	Mg/m³	Mg/m³	%	%	%	%	%	kN/m²	Degrees	kN/m²	Cm/Sec	Degrees	kN/m²	MN/m²
BH01	4.50-4.95	DS/SPT	Gravelly CLAY of high plasticity	CHG	16	18	17	46	1.98	1.77	2.65	11.6	51	19	32					7.20×10^{-8}	25	29	3.8
	7.50-7.95	DS/SPT	Very clayey GRAVEL of intermediate plasticity	GCI	8	14	28	50	1.82	1.66	2.64	13.0	38	15	21					8.46×10^{-8}	27	28	8.9
BH03	4.50-4.87	DS/SPT	Clayey GRAVEL of low plasticity	GCL	4	8	22	66	1.73	1.51	2.68	13.0	33	14	19			35	5	5.67×10^{-7}			8.5
	7.50-7.95	DS/SPT	Gravelly CLAY of high plasticity	CHG	23	38	22	25	2.07	1.76	2.65	17.8	53	22	31					4.76×10^{-8}	24	30	3.5

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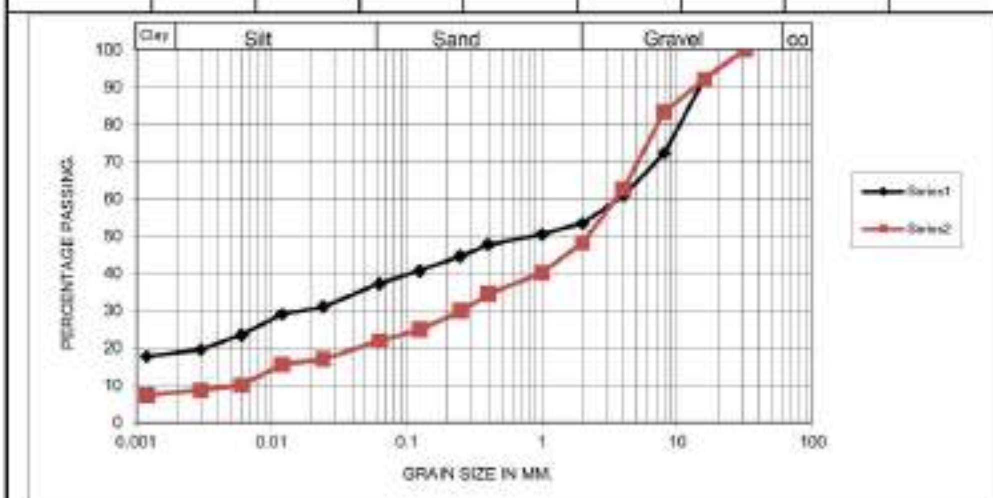
UNIVERSITY OF DAR ES SALAAM.

COLLEGE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT
SOIL MECHANICS LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE: 10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION	

SIEVE ANALYSIS.

Operator:	B.Eshiwakwe	Checked:	Lugano	Approved:	F.Msafiri
Total mass dried sample: Mo:(g)		150	200		
BH ID		BH01	BH01		
Depth in Meters		4.50-4.95	7.50-7.85		
SERIES:		1	2		
GROUPS:					
Clay. %	< 0.002 mm	18	8		
Silty. %	0.002 - 0.06 mm	19	14		
Sand. %	0.06 - 2.0 mm	17	26		
Gravel. %	2.0 - 60 mm	46	52		



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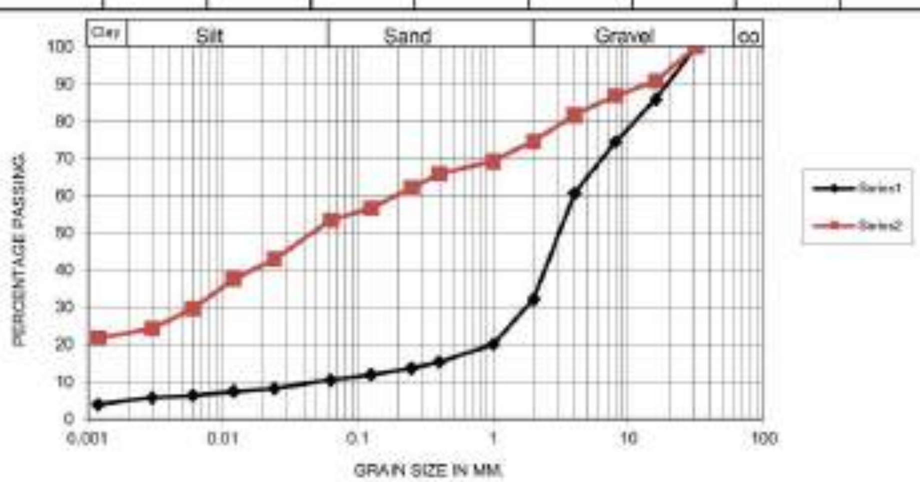
SOIL MECHANICS LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION		

SIEVE ANALYSIS.

Operator:	B.Eshiwakwe	Checked:	Lugano	Approved:	F.Msafiri
Total mass dried sample: Mo:(g)		200	150		
BH ID		BH03	BH03		
Depth in Meters		4.00-4.50	7.50-7.95		
SERIES:		1	2		
GROUPS:					
Clay. %	< 0.002 mm	4	23		
Silty. %	0.002 - 0.06 mm	6	30		
Sand. %	0.06 - 2.0 mm	22	22		
Gravel. %	2.0 - 60 mm	68	25		



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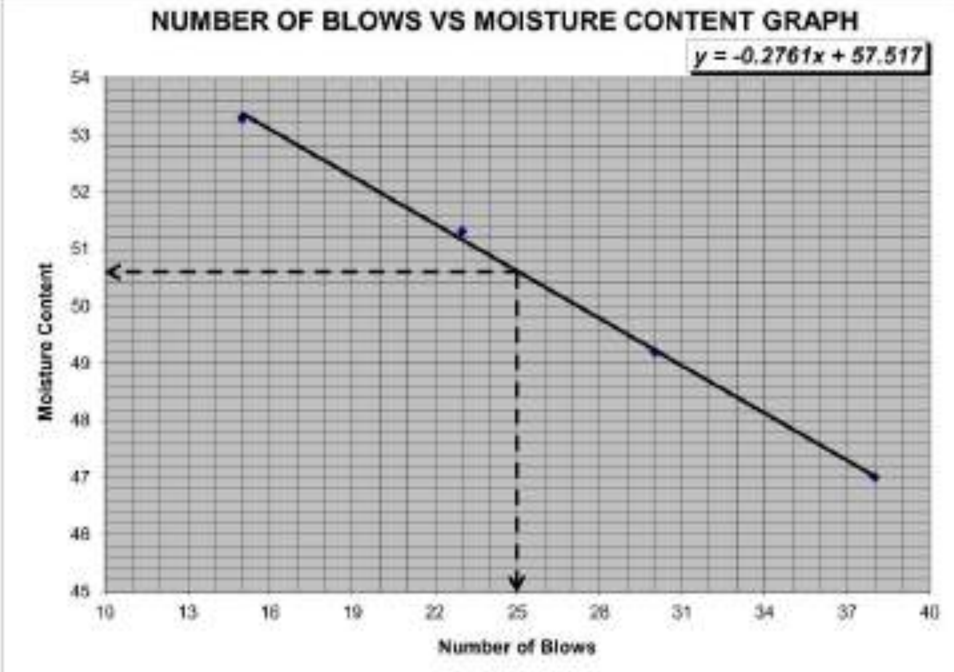
SOIL MECHANICS LABORATORY

ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION						
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY						
BHID:	BH01	Depth:	4.50-4.95		m		
Operator: B.Eshiwakwe	Checked:	Lugano	Approved:		F.Msafiri		

Type of Test		LIQUID LIMIT				PLASTIC LIMIT		
Container No.		J13	J14	J15	J16	N8	N7	
No. Of Blows (Liquid limit Test)		38	30	23	15			
Mass of wet soil + container	gm	33.06	33.49	34.31	30.11	21.37	21.34	
Mass of Dry soil + container	gm	27.28	28.12	28.62	24.38	20.12	20.07	
Mass of Container	gm	14.99	17.21	17.52	13.63	13.61	13.58	
Mass of Moisture	gm	5.78	5.37	5.69	5.73	1.25	1.27	
Mass of Dry soil	gm	12.29	10.91	11.1	10.75	6.51	6.49	
Moisture Content	%	47.0	49.2	51.3	53.3	19.2	19.6	



Liquid Limit	51	%
Plastic Limit	19	%
Plasticity Index	32	%

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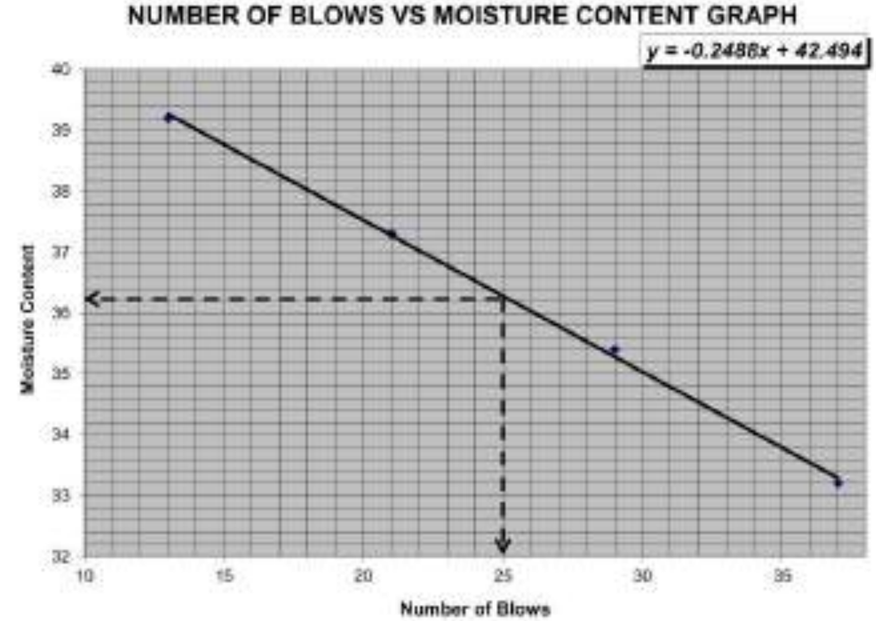
ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024	
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
BH ID:	BH01		Depth:	7.50-7.95 m				
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:			F.Msafiri	
Type of Test			LIQUID LIMIT			PLASTIC LIMIT		
Container No.		J4	J3	J2	J1	N2	N1	
No. Of Blows (Liquid limit Test)		37	29	21	13			
Mass of wet soil + container	gm	28.63	31.71	26.82	31.58	22.52	22.51	
Mass of Dry soil + container	gm	25.24	27.77	23.31	26.49	21.33	21.34	
Mass of Container	gm	15.03	16.64	13.90	13.50	13.67	13.47	
Mass of Moisture	gm	3.39	3.94	3.51	5.09	1.19	1.17	
Mass of Dry soil	gm	10.21	11.13	9.41	12.99	7.66	7.87	
Moisture Content	%	33.2	35.4	37.3	39.2	15.5	14.9	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



Liquid Limit	36	%
Plastic Limit	15	%
Plasticity Index	21	%

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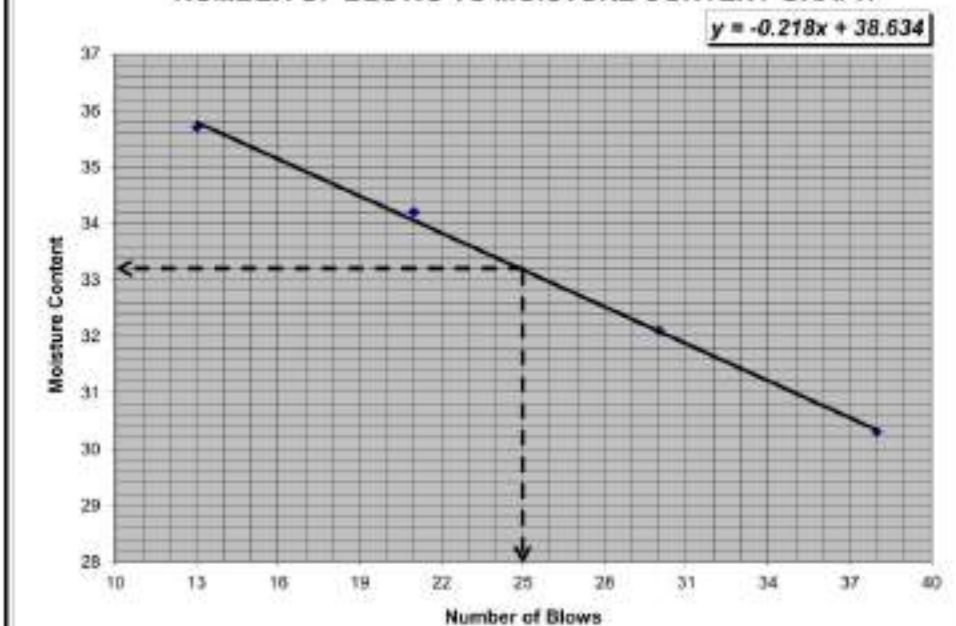
ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
BH ID:	BH03		Depth:	4.00-4.50		m		
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:			F.Msafiri	
Type of Test			LIQUID LIMIT			PLASTIC LIMIT		
Container No.		J28	J27	J26	J25	N14	N13	
No. Of Blows (Liquid limit Test)		38	30	21	13			
Mass of wet soil + container	gm	29.07	26.77	30.21	26.14	21.14	21.13	
Mass of Dry soil + container	gm	26.02	23.59	26.66	22.93	20.23	20.22	
Mass of Container	gm	15.96	13.69	16.27	13.94	13.74	13.73	
Mass of Moisture	gm	3.05	3.18	3.55	3.21	0.91	0.91	
Mass of Dry soil	gm	10.06	9.9	10.39	8.99	6.49	6.49	
Moisture Content	%	30.3	32.1	34.2	35.7	14.0	14.0	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



	Liquid Limit	33	%
	Plastic Limit	14	%
	Plasticity Index	19	%

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UNIVERSITY OF DAR ES SALAAM.

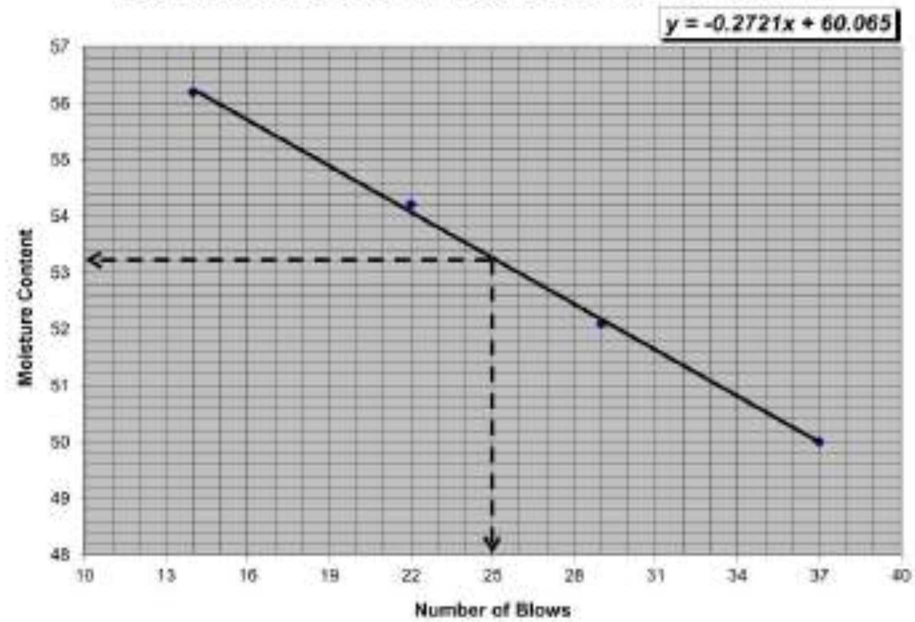
COLLEGE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT
SOIL MECHANICS LABORATORY

ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	04.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
BH ID:	BH03		Depth:	7.50-7.95		m		
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:			F.Msafiri	
Type of Test			LIQUID LIMIT			PLASTIC LIMIT		
Container No.		J20	J19	J18	J17	N10	N9	
No. Of Blows (Liquid limit Test)		37	29	22	14			
Mass of wet soil + container	gm	30.58	27.78	32.67	32.66	21.39	21.31	
Mass of Dry soil + container	gm	25.93	24.53	26.76	26.58	19.96	19.91	
Mass of Container	gm	16.63	18.29	15.86	15.76	13.63	13.61	
Mass of Moisture	gm	4.65	3.25	5.91	6.08	1.43	1.40	
Mass of Dry soil	gm	9.3	6.24	10.9	10.82	6.33	6.3	
Moisture Content	%	50.0	52.1	54.2	56.2	22.6	22.2	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



Liquid Limit	53	%
Plastic Limit	22	%
Plasticity Index	31	%

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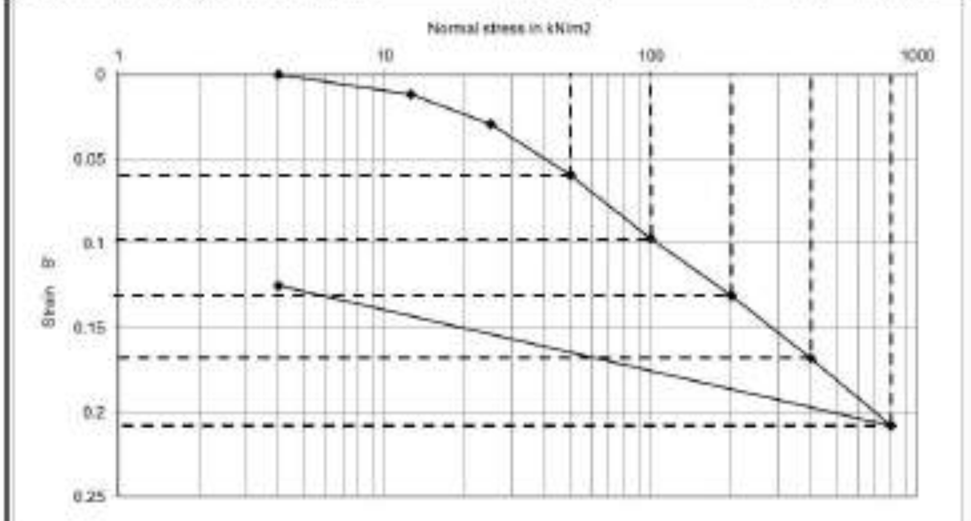
SOIL MECHANICS LABORATORY
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION						
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY						
BH ID:	BH01						
Depth	4.50-4.95 m						
Operator:	B.Eshiwakwe	Checked:	Lugano		Approved:	F. Msafiri	
		m		Sample type:			UD
Area:	Ao 44.18			Height:	Ho	19.2	
Water content: before test wo =		11.6	%	Water after test:		19.4	%
Voids ratio before test eo =		0.50					
Compressibility index C:		0.17					
Es value: First loading : Loading step from:			50 to 100			1.3	MN/m2
Es value: Second loading : Loading step from:			100 to 200			3.0	MN/m2
Es value: Third loading : Loading step from:			200 to 400			5.4	MN/m2
Es value: Fourth loading : Load step from			400 to 800			10.0	MN/m2



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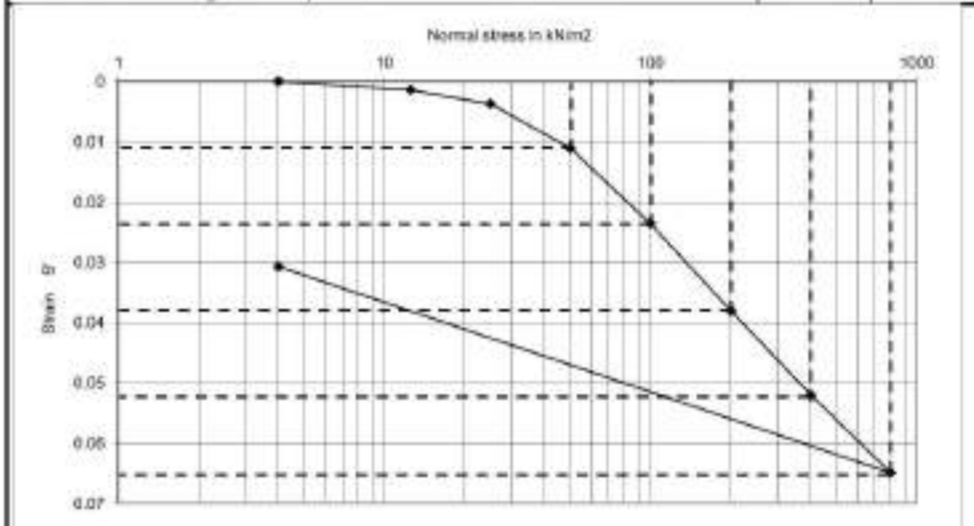
SOIL MECHANICS LABORATORY
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
BH ID:	BH01							
Depth	7.50-7.85							
Operator:	B.Eshiwakwe		Checked:	Lugano		Approved:	F. Msafiri	
			m		Sample type:			UD
Area:	Ao	38.48			Height:	Ho	19.2	
Water content: before test wo =			13.6	%	Water after test:		21.4	%
Voids ratio before test eo =			0.46					
Compressibility index C:			0.07					
Es value: First loading : Loading step from:				50 to 100			4.0	MN/m2
Es value: Second loading : Loading step from:				100 to 200			6.9	MN/m2
Es value: Third loading : Loading step from:				200 to 400			14.3	MN/m2
Es value: Fourth loading : Load step from				400 to 800			31.0	MN/m2



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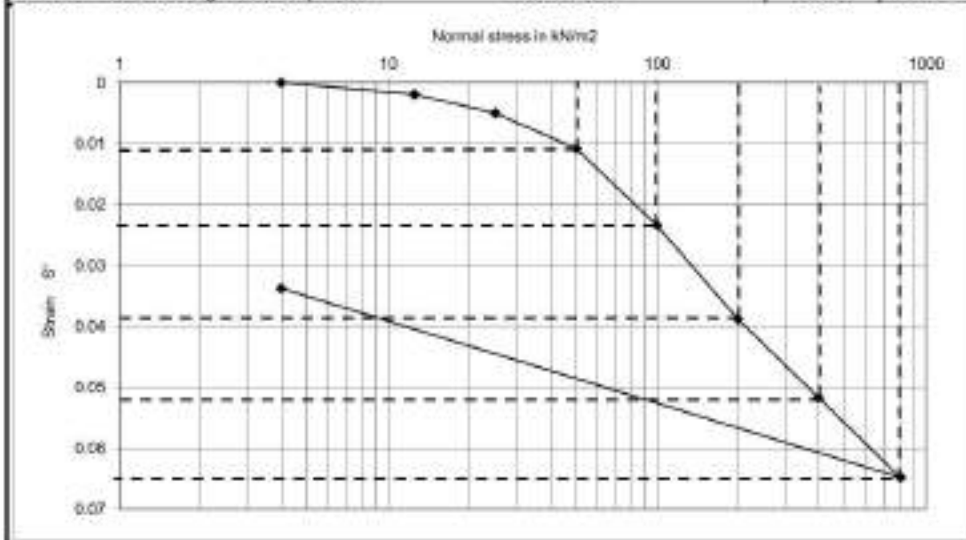
SOIL MECHANICS LABORATORY
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION						
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY						
BH ID:	BH03						
Depth	4.50-4.67						
Operator:	B.Eshiwakwe		Checked:	Lugano	Approved:	F. Msafiri	
			m		Sample type:		UD
Area:	Ao	44.18			Height: Ho	19.2	
Water content: before test wo =			13.6	%	Water after test:	19.8	%
Voids ratio before test eo =			0.41				
Compressibility index C:			0.07				
Es value: First loading : Loading step from:				50 to 100		4.0	MN/m2
Es value: Second loading : Loading step from:				100 to 200		6.5	MN/m2
Es value: Third loading : Loading step from:				200 to 400		15.5	MN/m2
Es value: Fourth loading : Load step from				400 to 800		30.5	MN/m2



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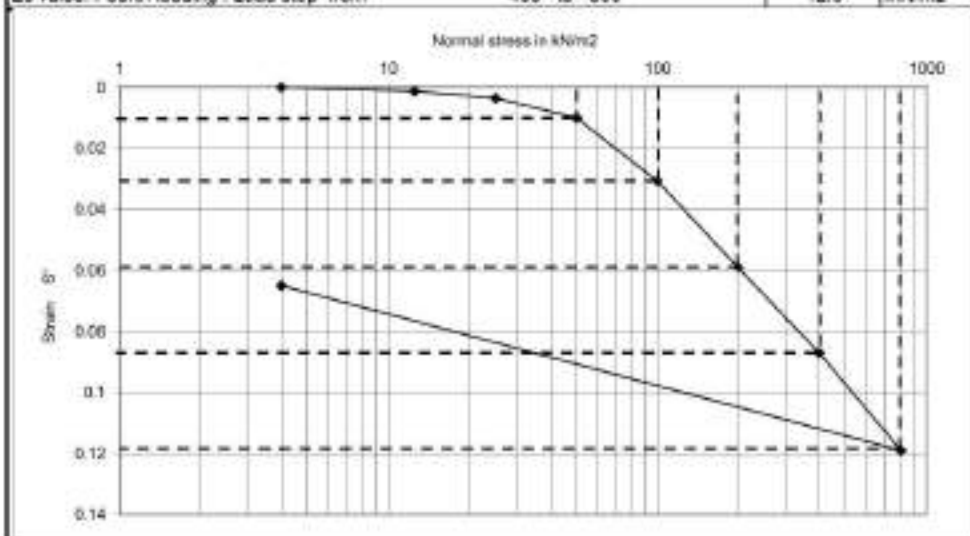
SOIL MECHANICS LABORATORY
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
BH ID:	BH03							
Depth	7.50-7.95							
Operator:	B.Eshiwakwe		Checked:	Lugano		Approved:	F. Msafiri	
			m		Sample type:			UD
Area:	Ao	44.18			Height:	Ho	19.2	
Water content: before test wo =			17.8	%	Water after test:		25.6	%
Voids ratio before test eo =			0.48					
Compressibility index C:			0.14					
Es value: First loading : Loading step from:				50 to 100			2.4	MN/m2
Es value: Second loading : Loading step from:				100 to 200			3.5	MN/m2
Es value: Third loading : Loading step from:				200 to 400			7.1	MN/m2
Es value: Fourth loading : Load step from				400 to 800			12.5	MN/m2



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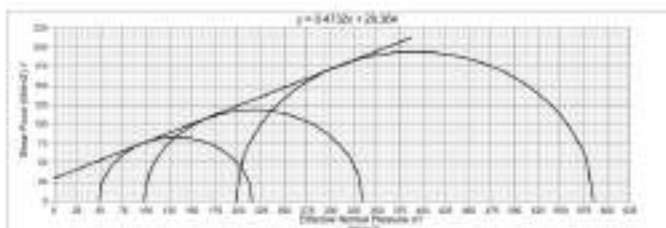
COLLEGE OF ENGINEERING AND TECHNOLOGY

TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT

SOIL MECHANICS AND FOUNDATION ENGINEERING LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE:10/04/2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPICIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION	
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY	

Triaxial Shear Test			Test	σc	σ_3'	σ_1'	$(\sigma_1-\sigma_3)$	u_f
Mohr's Circles	BH ID:	BH01	No.	kN/m²	kN/m²	kN/m²	kN/m²	kN/m²
	Depth:	4.50-4.88 m	1	50	49	215	166	21
Type: Cu with pore water measurement			2	100	98	336	237	22
Failure criteria: σ_1' / σ_3' Max.			3	200	187	565	388	23
			Ø' =	25	Degrees	C' =	29	kN/m²



Operator:	B Eshiwalwa	Checked:	Lugano	Approved:	F Mwafie

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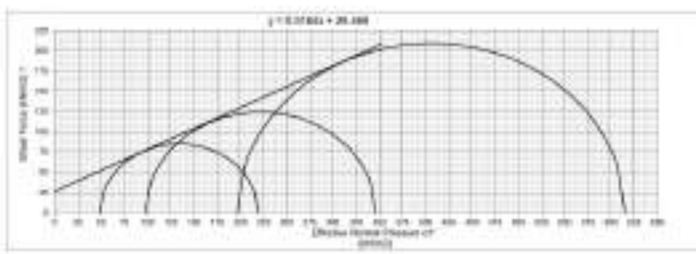
COLLEGE OF ENGINEERING AND TECHNOLOGY

TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT

SOIL MECHANICS AND FOUNDATION ENGINEERING LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE:10/04/2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPICL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION	
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY	

Triaxial Shear Test			Test	σc	σ_3'	σ_1'	$(\sigma_1-\sigma_3)_f$	u_f
Mohr's Circles	BH ID:	BH01	No.	kN/m²	kN/m²	kN/m²	kN/m²	kN/m²
	Depth:	7.50-7.85 m	1	50	49	219	170	21
Type: Cu with pore water measurement			2	100	98	346	248	22
Failure criteria: σ_1' / σ_3' Max			3	200	197	615	418	23
			Φ' =	27	Degrees	C' =	26	kN/m²



Operator:	B.Eshiwalwe	Checked:	Lugano	Approved:	F.Mbalte

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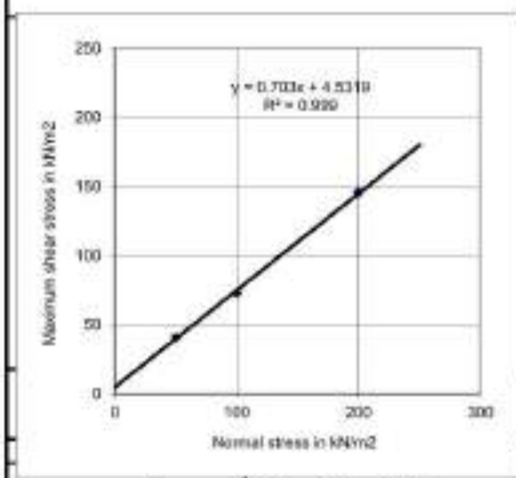
Department of Transportation and Geotechnical Engineering
P. O. Box 35131, Dar es salaam

DIRECT SHEAR TEST

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE:	10-04-2024.
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION		
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY		
BH ID:	BH03		
DEPTH:	4.50-4.67 m		

Operator:	B.Eshiwakwe
Checked:	Lugano
Approved:	F.Msafiri
Water content:	Natural
Applied density:	Natural



Normal stress kN/m²	Max. shear stress kN/m²
0	
50	40.9828
100	72.8879
200	145.7896
250	

Angle of internal friction:	35	o
Cohesion: C	5	kN/m²

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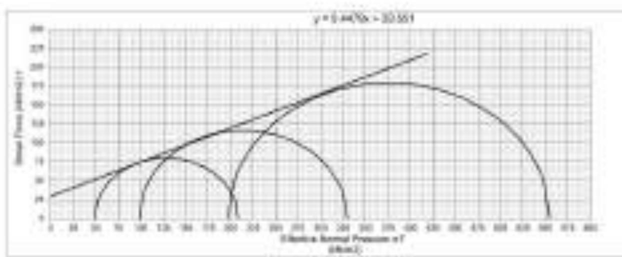
COLLEGE OF ENGINEERING AND TECHNOLOGY

TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT

SOIL MECHANICS AND FOUNDATION ENGINEERING LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:11/04/2024	
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPICS, PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
Triaxial Shear Test			Test	σ_3	σ_3'	σ_1'	$(\sigma_1-\sigma_3)/2$	u
Mohr's Circles	BH ID:	BH03	No.	kN/m²	kN/m²	kN/m²	kN/m²	kN/m²
	Depth:	7.50-7.95 m	1	50	49	268	159	21
Type: Cu with pore water measurement			2	100	96	338	200	22
Failure criteria: σ_1' / σ_3' Max			3	200	197	888	358	23
			Φ' =	24	Degrees	C' =	38	kN/m²



Operator:	B.Eshwalwe	Checked:	Lugano	Approved:	F.Mwafai

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College of Engineering and Technology
Department of Transportation and Geotechnical Engineering
Soil Mechanics Laboratory

KEY TO SYMBOLS
To column 3: uds = undisturbed d = disturbed Spt = Standard penetration test C = core sample O = organic Pt = peat A1 = Area 1
To column 5: G = gravel S = sand M = silt C = Clay P = poorly graded L = low plasticity H = high plasticity I = Intermediate Plasticity V = Very high plasticity E = Extremely high plasticity

COMPILATION OF MECHANICAL COEFFICIENTS

CLIENT: STATE MINING CORPORATION (STAMICO)

PROJECT: THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPICL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUNVA VILLAGE SEGESE WARD MSALALA DISTRICT IN SHINYANGA REGION

CONSULTANT: UNIVERSITY OF DAR ES SALAAM, COLLEGE OF ENGINEERING AND TECHNOLOGY

Operator: B.Eshiwalwe Checked: Lugano Approved: F.Mwafiri Date: 13/04/2024

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			20	21
			British Soil Classification System		Particle size distribution				Densities				Consistency			Modified Proctor		California Bearing Ratio			Permeability	Oedometer
TP ID	Sample Depth (m)	Sample type	Description	Group Symbol	Clay	Silt	Sand	Gravel	Bulk Density	Dry density	Density of solids	Natural water	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Dry Density	Optimum Moisture Content	CBR	CBR	CBR	Coefficient of permeability	Mv
Symbols									ρ	ρd	ρs	w	LL	PL	Ip	ρdmax	Wopt	CBR			K-Value	Eo
Units					%	%	%	%	Mg/m³	Mg/m³	Mg/m³	%	%	%	%	Kg/m³	%	%			Cm/Sec	Mv
TP01	0.50-1.30	BULK	Very clayey GRAVEL of intermediate plasticity	GC	10	12	17	61			2.65		39	19	20	2073	8.0	10	30	33	3.80E-08	
BP01	0.20-0.80	BULK	CLAY of high plasticity	CH	11	66	20	3			2.66		51	23	28	1796	15.1	3	4	6	7.74E-08	3.3
BP02	0.50-1.00	BULK	CLAY of high plasticity	CH	33	34	22	2			2.64		52	22	30	1833	11.1		3	3	5.40E-08	3.1

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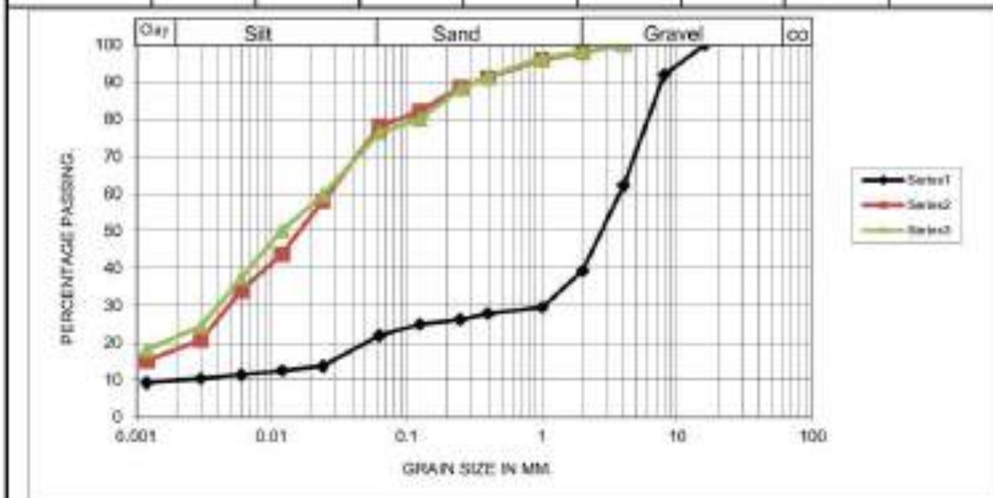
COLLEGE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT
SOIL MECHANICS LABORATORY

CLIENT:	STATE MINING CORPORATION(STAMICO)	DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION		

SIEVE ANALYSIS.

Operator:	B.Eshiwakwe		Checked:	Lugano	Approved:	F.Msafiri
Total mass dried sample: Mo:(g)			150	50	50	
TP ID			TP01	BP01	BP02	
Depth in Meters			0.50-1.30	0.30-0.60	0.50-1.00	
SERIES:			1	2	3	
GROUPS:						
Clay. %	< 0.002 mm		10	18	22	
Silty. %	0.002 - 0.06 mm		12	60	54	
Sand. %	0.06 - 2.0 mm		17	20	22	
Gravel. %	2.0 - 60 mm		61	2	2	



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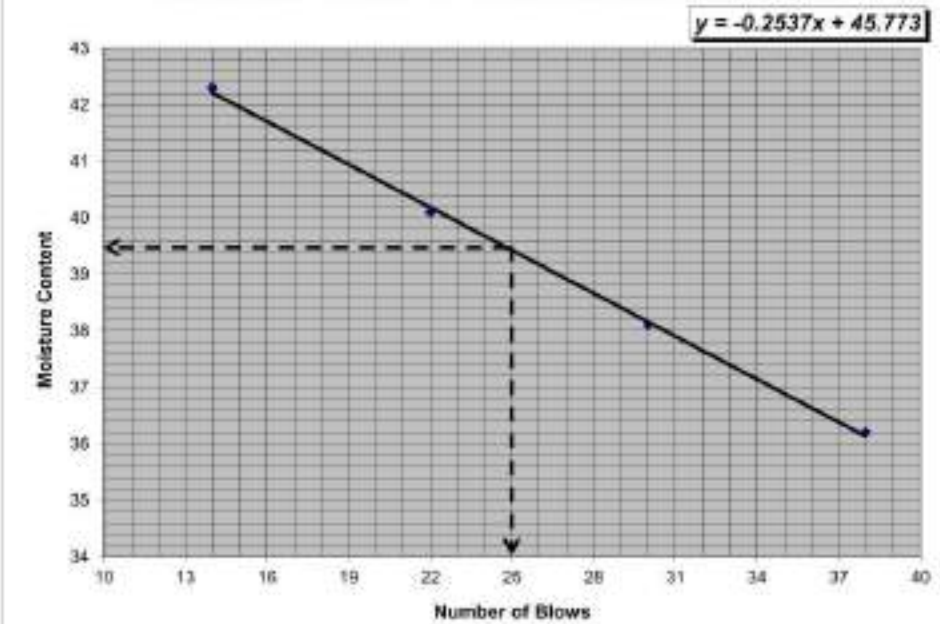
SOIL MECHANICS LABORATORY

ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024	
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
TP ID:	TP01		Depth:	0.50-1.30		m		
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:		F.Msafiri		
Type of Test			LIQUID LIMIT			PLASTIC LIMIT		
Container No.		J20	J19	J18	J17	N10	N9	
No. Of Blows (Liquid limit Test)		38	30	22	14			
Mass of wet soil + container	gm	34.45	30.18	31.98	33.16	21.38	21.37	
Mass of Dry soil + container	gm	30.28	25.59	26.69	27.35	20.16	20.17	
Mass of Container	gm	18.76	13.55	13.49	13.62	13.71	13.70	
Mass of Moisture	gm	4.17	4.59	5.29	5.81	1.22	1.20	
Mass of Dry soil	gm	11.52	12.04	13.2	13.73	6.45	6.47	
Moisture Content	%	36.2	38.1	40.1	42.3	18.9	18.5	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



	Liquid Limit	39	%
	Plastic Limit	19	%
	Plasticity Index	20	%

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ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

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CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024	
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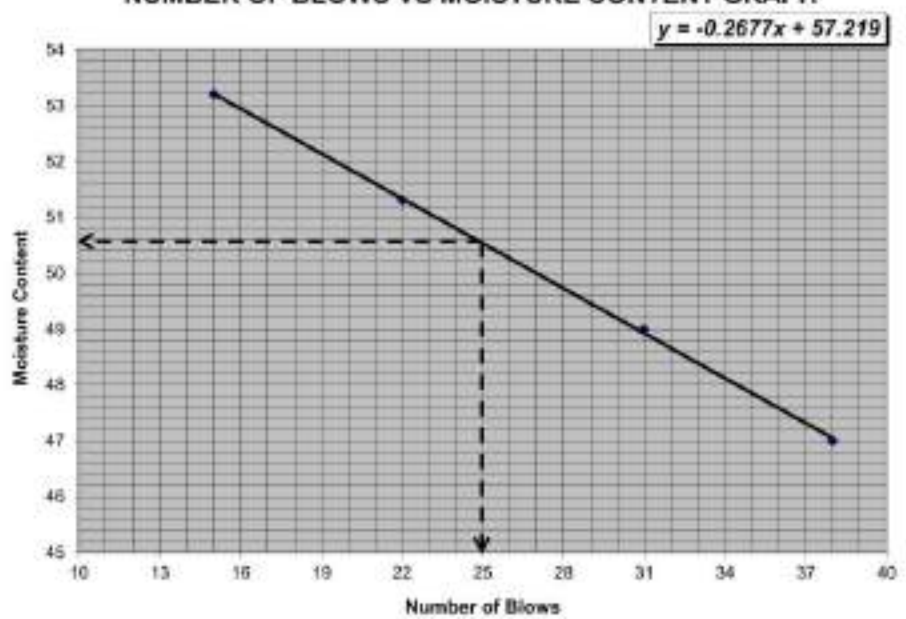
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
TP ID:	BP01		Depth:	0.30-0.60		m		
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:			F.Msafiri	
Type of Test		LIQUID LIMIT				PLASTIC LIMIT		
Container No.		J12	J11	J10	J9	N6	N5	
No. Of Blows (Liquid limit Test)		38	31	22	15			
Mass of wet soil + container	gm	30.12	30.94	32.14	30.77	20.51	21.47	
Mass of Dry soil + container	gm	25.60	26.04	25.99	25.57	19.22	19.98	
Mass of Container	gm	15.99	16.05	13.99	15.80	13.64	13.61	
Mass of Moisture	gm	4.52	4.90	6.15	5.2	1.29	1.49	
Mass of Dry soil	gm	9.61	9.99	12	9.77	5.58	6.37	
Moisture Content	%	47.0	49.0	51.3	53.2	23.1	23.4	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



	Liquid Limit	51	%
	Plastic Limit	23	%
	Plasticity Index	28	%
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TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT

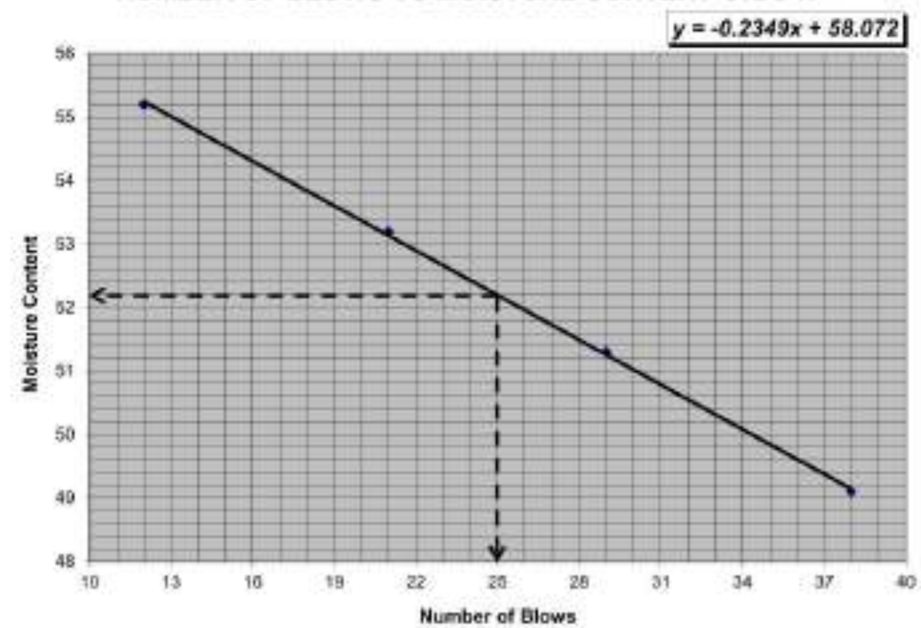
SOIL MECHANICS LABORATORY

ATTERBERG LIMITS DETERMINATION <CASAGRANDE METHOD>

TEST METHOD BS 1377: Part 2: 1990: 4.5

CLIENT:	STATE MINING CORPORATION(STAMICO)					DATE:	10.04.2024	
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY-FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
TP ID:	BP02		Depth:	0.50-1.00		m		
Operator: B.Eshiwakwe	Checked:		Lugano	Approved:		F.Msafiri		
Type of Test			LIQUID LIMIT			PLASTIC LIMIT		
Container No.		J24	J23	J22	J21	N12	N11	
No. Of Blows (Liquid limit Test)		38	29	21	12			
Mass of wet soil + container	gm	31.99	31.11	30.68	33.91	20.82	21.01	
Mass of Dry soil + container	gm	26.04	25.58	25.18	28.52	19.53	19.64	
Mass of Container	gm	13.92	14.80	14.84	18.75	13.51	13.38	
Mass of Moisture	gm	5.95	5.53	5.5	5.39	1.29	1.37	
Mass of Dry soil	gm	12.12	10.78	10.34	9.77	6.02	6.26	
Moisture Content	%	49.1	51.3	53.2	55.2	21.4	21.9	

NUMBER OF BLOWS VS MOISTURE CONTENT GRAPH



Liquid Limit	52	%
Plastic Limit	22	%
Plasticity Index	30	%

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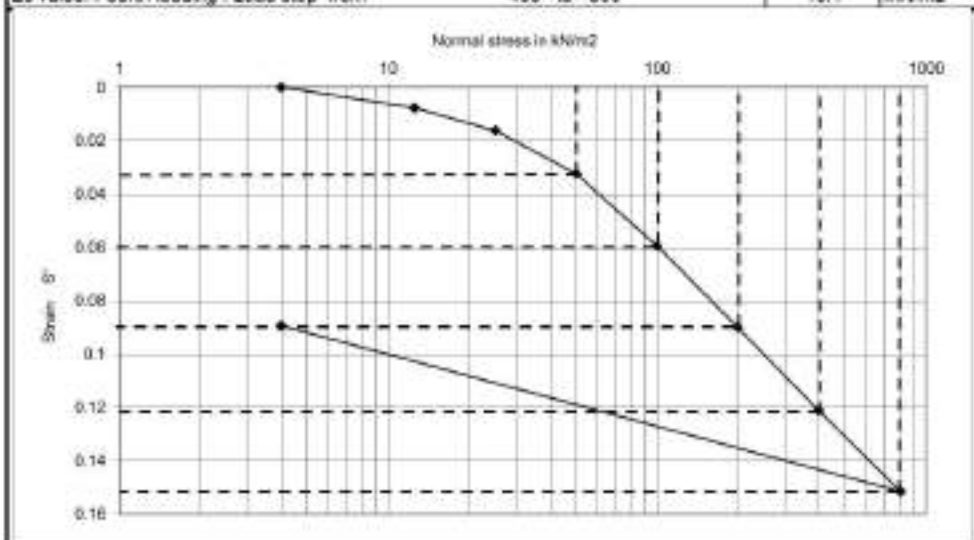
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
TP ID:	BP01							
Depth	0.30-0.60							
Operator:	B.Eshiwakwe		Checked:	Lugano		Approved:	F. Msafiri	
			m		Sample type:			UD
Area:	Ao	44.18			Height:	Ho	19.2	
Water content: before test wo =			15.1	%	Water after test:		24.0	%
Voids ratio before test eo =			0.72					
Compressibility index C:			0.18					
Es value: First loading : Loading step from:				50 to 100			1.9	MN/m2
Es value: Second loading : Loading step from:				100 to 200			3.3	MN/m2
Es value: Third loading : Loading step from:				200 to 400			6.4	MN/m2
Es value: Fourth loading : Load step from				400 to 800			13.1	MN/m2



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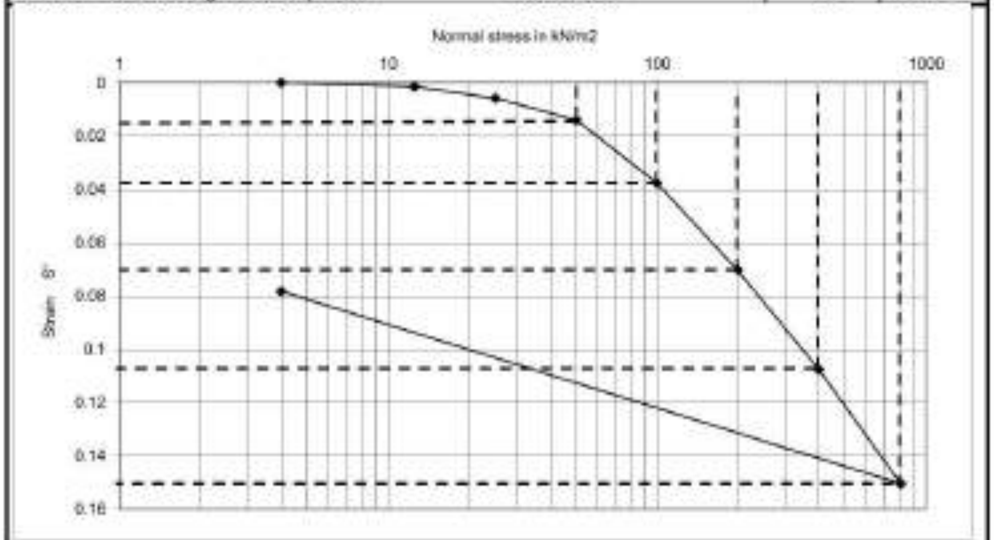
TEST METHOD BS 1377 Part 6: 1990

COMPRESSION TEST (LOAD SETTLEMENT CURVE)

CLIENT:	STATE MINING CORPORATION(STAMICO)						DATE:	10.04.2024
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS(ASGM) MERCURY- FREE GOLD PROCESSING DEMOSTRATION CENTRE AT BUMVA VILLAGE,SEGESE WARD,MSALALA DISTRICT IN SHINYANGA REGION							
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM,COLLEGE OF ENGINEERING AND TECHNOLOGY							
TP ID:	BP02							
Depth	0.50-1.00							
Operator:	B.Eshiwakwe		Checked:	Lugano		Approved:	F. Msafiri	
			m		Sample type:			UD
Area:	Ao	44.18			Height:	Ho	19.2	
Water content: before test wo =			17.1	%	Water after test:		25.5	%
Voids ratio before test eo =			0.78					
Compressibility index C:			0.19					
Es value: First loading : Loading step from:				50 to 100			2.1	MN/m2
Es value: Second loading : Loading step from:				100 to 200			3.1	MN/m2
Es value: Third loading : Loading step from:				200 to 400			5.4	MN/m2
Es value: Fourth loading : Load step from				400 to 800			9.3	MN/m2



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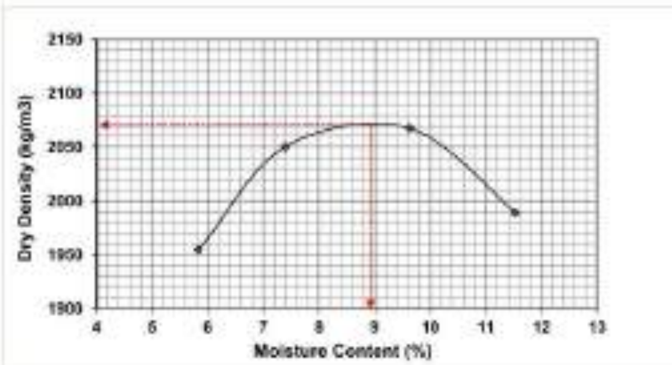
MOISTURE DENSITY RELATIONSHIP OF SOILS

BS 1377 : Part 4 : 1990 (MODIFIED)

CLIENT:	STATE MINING CORPORATION(STAMICO)
PROJECT NAME:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM, COLLEGE OF ENGINEERING AND TECHNOLOGY
LOCATION:	BUMVA VILLAGE, SEGESE WARD.
TP ID:	TP01 DEPTH: (0.50 - 1.30) m
TESTED BY:	B.Eshiwakwe / Checked by: Lugano / Approved by: F.Msafiri / Date: 10.04.2024

Number of layers		5	5	5	5		
Number of blows/layer	No.	27	27	27	27		
Water added	%	2%	4%	6%	8%		
Wt. of mould + wet soil	g	6205	6338	6403	6355		
Wt. of mould	g	4137	4137	4137	4137		
Wt. of wet soil	g	2069	2203	2267	2218		
Volume of mould	cc	1000	1000	1000	1000		
Wet density	kg/m³	2069	2203	2267	2218		
Dry density	kg/m³	1955	2051	2066	1989		

CONT. NUMBER		R7	B84	N30	B14		
Wt of wet soil + cont.	g	208.85	232.87	209.09	238.49		
Wt of dry soil + cont.	g	198.79	218.51	192.86	216.37		
Wt of cont.	g	26.29	24.42	24.22	24.33		
Wt of water	g	10.06	14.36	16.23	22.12		
Dry soil	g	172.50	194.09	168.64	192.04		
Moisture content	%	5.8	7.4	9.6	11.5		



MAXIMUM DRY DENSITY : 2072 kg/m³

OPTIMUM MOISTURE : 8.9 %

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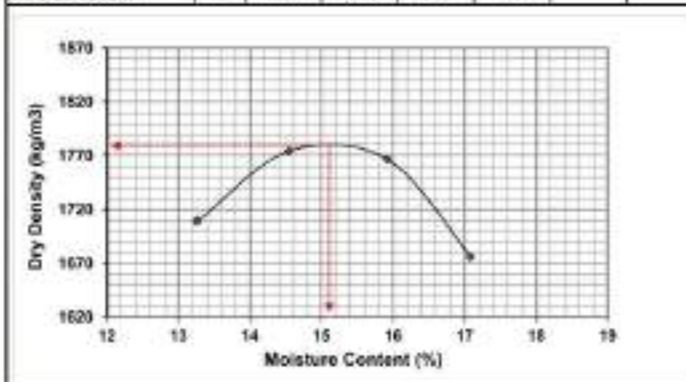
MOISTURE DENSITY RELATIONSHIP OF SOILS

BS 1377 : Part 4 : 1990 (MODIFIED)

CLIENT:	STATE MINING CORPORATION(STAMICO)
PROJECT NAME:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM, COLLEGE OF ENGINEERING AND TECHNOLOGY
LOCATION:	BUMVA VILLAGE, SEGESE WARD.
TP ID:	BP 01 DEPTH: (0.30 - 0.60) m
TESTED BY:	B.Eshiwakwe · Checked by: Lugano · Approved by: F.Msafiri · Date: 10.04.2024

Number of layers		5	5	5	5		
Number of blows/layer	No.	27	27	27	27		
Water added	%	2%	4%	6%	8%		
Wt. of mould + wet soil	g	6073	6169	6184	6099		
Wt. of mould	g	4137	4137	4137	4137		
Wt. of wet soil	g	1936	2032	2048	1962		
Volume of mould	cc	1000	1000	1000	1000		
Wet density	kg/m^3	1936	2032	2048	1962		
Dry density	kg/m^3	1709	1774	1766	1676		

CONT. NUMBER		L6	K18	L19	B1		
Wt of wet soil + cont.	g	186.37	198.40	233.54	213.15		
Wt of dry soil + cont.	g	167.60	176.29	204.82	185.66		
Wt of cont.	g	26.02	24.23	24.44	24.71		
Wt of water	g	18.77	22.11	28.72	27.49		
Dry soil	g	141.58	152.06	180.38	160.95		
Moisture content	%	13.3	14.5	15.9	17.1		



MAXIMUM DRY DENSITY : 1780 kg/m^3

OPTIMUM MOISTURE : 15.1 %

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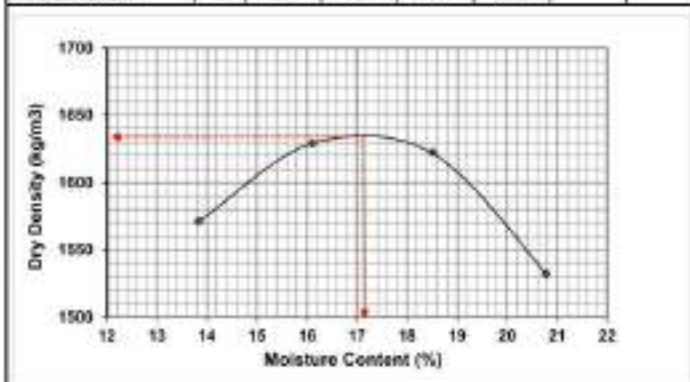
MOISTURE DENSITY RELATIONSHIP OF SOILS

BS 1377 : Part 4 : 1990 (MODIFIED)

CLIENT:	STATE MINING CORPORATION(STAMICO)
PROJECT NAME:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM, COLLEGE OF ENGINEERING AND TECHNOLOGY
LOCATION:	BUMVA VILLAGE, SEGESE WARD.
TP ID:	BP 02 DEPTH: (0.50 - 1.00) m
TESTED BY:	B.Eshiwakwe; Checked by: Lugano; Approved by: F.Msafiri; Date: 10.04.2024

Number of layers		5	5	5	5		
Number of blows/layer	No.	27	27	27	27		
Water added	%	2%	4%	6%	8%		
Wt. of mould + wet soil	g	5925	6028	6059	5987		
Wt. of mould	g	4137	4137	4137	4137		
Wt. of wet soil	g	1789	1892	1923	1851		
Volume of mould	cc	1000	1000	1000	1000		
Wet density	kg/m³	1789	1892	1923	1851		
Dry density	kg/m³	1571	1629	1622	1532		

CONT. NUMBER		K14	J8	P3	K11		
Wt of wet soil + cont.	g	193.67	196.21	204.76	228.51		
Wt of dry soil + cont.	g	173.08	172.23	176.85	193.46		
Wt of cont.	g	24.32	23.36	24.07	24.78		
Wt of water	g	20.59	23.98	28.11	35.05		
Dry soil	g	148.76	148.87	151.78	168.68		
Moisture content	%	13.8	16.1	18.5	20.8		



MAXIMUM DRY DENSITY : 1635 kg/m³
OPTIMUM MOISTURE : 17.1 %

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SOIL MECHANICS LABORATORY

CALIFORNIA BEARING RATIO (CBR)		BS 1377: PART 4: 1990	
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPCIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION		
CLIENT:	STATE MINING CORPORATION (STAMICO)		
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM	TESTED BY:	[illegible]
LOCATION:	BUMVA VILLAGE, SEGESE WARD	APPROVED BY:	F. Masfiri
TP ID:	TP 01 DEPTH: (0.80 - 1.30) m	DATE:	13/04/2024

SPECIMEN MOULDING

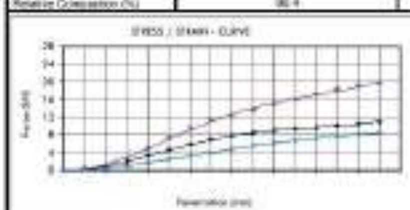
Natural Moisture Content (NMC) %	0.26	Water to be added (5000 x (OMC - NMC)/(100 + NMC))		317	ml
CBR Mould No.		A3	B4	C1	
Compaction Effort		2.5 kg/3 layers/62 blows	4.5 kg/5 layers/30 blows	4.5 kg/5 layers/62 blows	
Mass of Mould + Compacted Soil	g	12134	12403	13405	
Mass of Empty Mould	g	7422	7454	8191	
Mass of Compacted Soil	g	4712	4958	5244	
Volume of Mould	cm³	2306	2305	2306	
Bulk Density of Specimen	kg/m³	2044	2103	2275	
Moisture Tin Number	No.	7676	4/14	5000	
Mass of Wet Soil + Tin	g	214.54	218.15	225.77	
Mass of Dry Soil + Tin	g	198.97	201.87	208.48	
Mass of Empty Tin	g	24.51	24.31	24.19	
Mass of Water	g	15.87	16.28	17.31	
Mass of Dry Soil	g	174.16	177.56	184.27	
Moisture Content	%	9.11	9.17	9.29	
Dry Density of Specimen	kg/m³	1874	1981	2086	
Reference Data (MDD/OMC)		MDD 2073 kg/m³	OMC 8.6 %		

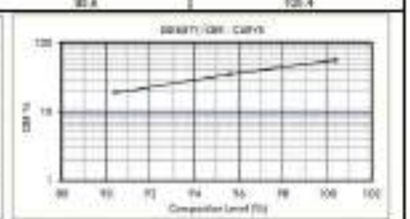
SWELL

Gauge Reading on Soaking Day (R1)	mm	0.00	0.00	0.00
Gauge Reading after 4 days (R2)	mm	1.20	1.00	0.70
Swell Value (R2-R1)x100/127	%	0.91	0.79	0.65

SPECIMEN PENETRATION

CBR Tester No.	C11				Rate of Penetration 1.27 mm/min				Ring Factor		0.0107 kN/div	
Mould No.	A3				B4				C1			
Penetration of Plunger (mm)	Dial Gauge Reading (division)		Force on Plunger (kN)		Dial Gauge (division)		Force on Plunger (kN)		Dial Gauge (division)		Force on Plunger (kN)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
0.0	0		0		0		0		0		0.00	
0.50	20		0.21		30		0.32		25		0.27	
1.00	41		0.42		61		0.73		80		0.91	
1.50	80		0.86		179		1.62		219		2.40	
2.00	156		1.67		318		3.32		469		4.82	
2.50	234		2.50		430		4.03		650		7.38	
3.00	300		3.21		548		5.03		905		9.68	
3.50	366		3.94		649		6.03		1219		11.43	
4.00	440		4.79		720		7.73		1348		12.20	
4.50	511		5.47		780		8.35		1266		13.18	
5.00	575		6.15		838		8.03		1300		14.07	
5.50	623		6.67		873		9.31		1500		16.06	
6.00	670		7.28		905		9.68		1818		17.22	
6.50	734		7.84		960		10.36		1708		18.19	
7.00	786		8.08		973		10.42		1758		18.13	
7.50	786		8.41		1075		11.97		1848		19.68	
CBR	Top	Bottom	Corrected Value		Top	Bottom	Corrected Value		Top	Bottom	Corrected Value	
At 2.5 mm (T = 13.2 kN)	19				33				56			
At 5.0 mm (T = 20.0 kN)	31				45				74			
Recorded CBR Value (%)	19				35				58			
Relative Compaction (%)	90.4				95.6				100.4			





REPORTED CBR	At 90 % MDD	18	At 93 % MDD	26	At 95 % MDD	33	At 98 % MDD	45

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SOIL MECHANICS LABORATORY

CALIFORNIA BEARING RATIO (CBR) — BS 1377: PART 4: 1990

PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPCIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION		
CLIENT:	STATE MINING CORPORATION (STAMICO)		
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM	TESTED BY:	G.Eshiwaire
LOCATION:	BUMVA VILLAGE, SEGESE WARD	APPROVED BY:	F. Masfiri
TP ID:	BP 01 DEPTH: (0.30 - 0.60) m	DATE:	13/04/2024

SPECIMEN MOULDING

Natural Moisture Content (NMC) %		1.33	Water to be added (3000 x (OMC - NMC)/(100 + NMC))	815 ml
CBR Mould No.		**A1**	**B11**	**C3**
Compaction Effort		2.5 kg/3 layers/62 blows	4.5 kg/5 layers/30 blows	4.5 kg/5 layers/62 blows
Mass of Mould + Compacted Soil	g	11089	11917	11978
Mass of Empty Mould	g	7061	7265	7321
Mass of Compacted Soil	g	4228	4652	4657
Volume of Mould	cm³	2306	2306	2306
Bulk Density of Specimen	Kg/m³	1834	1901	2020
Moisture Tin Number	No	R10	20	13
Mass of Wet Soil + Tin	g	196.21	175.30	177.84
Mass of Dry Soil + Tin	g	175.32	156.04	158.66
Mass of Empty Tin	g	24.67	20.67	20.67
Mass of Water	g	21.98	19.28	19.18
Mass of Dry Soil	g	169.05	131.37	133.78
Moisture Content	%	14.59	14.68	14.34
Dry Density of Specimen	Kg/m³	1556	1692	1767
Reference Data (MDD/OMC)		MDD 1788 Kg/m³	OMC 14.1 %	

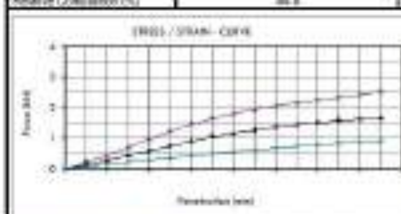
SWELL

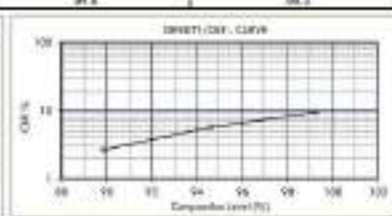
		A1	B11	C3
Gauge Reading on Soaking Day (R1)	mm	0.00	0.00	0.00
Gauge Reading after 4 days (R2)	mm	1.60	1.31	0.65
Swell Value (R2-R1)x100/127	%	1.26	1.03	0.75

SPECIMEN PENETRATION

CBR Tester No.: C11 — Rate of Penetration: 1.27 mm/min — Ring Factor: 0.0107 kN/div

Mould No.	A1				B11				C3			
Penetration of Plunger (mm)	Dial Gauge Reading (division)		Force on Plunger (kN)		Dial Gauge (division)		Force on Plunger (kN)		Dial Gauge (division)		Force on Plunger (kN)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
0.0	0		0		0		0		0		0.00	
0.50	8		0.09		15		0.16		20		0.22	
1.00	14		0.15		22		0.24		34		0.37	
1.50	21		0.22		40		0.42		60		0.72	
2.00	27		0.28		55		0.58		90		0.98	
2.50	33		0.35		71		0.76		115		1.23	
3.00	44		0.43		85		0.91		142		1.50	
3.50	48		0.49		99		1.06		155		1.65	
4.00	52		0.55		107		1.15		167		1.79	
4.50	58		0.62		117		1.26		178		1.90	
5.00	63		0.68		128		1.36		188		2.03	
5.50	68		0.74		134		1.43		200		2.14	
6.00	74		0.79		142		1.52		213		2.25	
6.50	78		0.83		148		1.58		218		2.33	
7.00	82		0.86		152		1.63		227		2.43	
7.50	88		0.91		158		1.68		235		2.51	
CBR	Top	Bottom	Corrected Value		Top	Bottom	Corrected Value		Top	Bottom	Corrected Value	
At 2.5 mm (T = 13.2 kN)	3				6				9			
At 5.0 mm (T = 20.0 kN)	3				7				10			
Recorded CBR Value (%)	3				6				9			
Relative Compaction (%)	88.8				94.8				98.3			





REPORTED CBR	At 90 % MDD	3	At 93 % MDD	4	At 95 % MDD	6	At 100 % MDD	8

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COLLEGE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION AND GEOTECHNICAL ENGINEERING DEPARTMENT
SOIL MECHANICS LABORATORY

CALIFORNIA BEARING RATIO (CBR) — **BS 1377: PART 4: 1990**

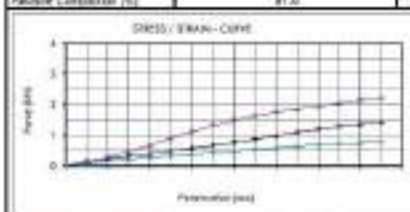
PROJECT:	THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIPCIL PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS (ASGM) MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION		
CLIENT:	STATE MINING CORPORATION (STAMICO)		
CONSULTANT:	UNIVERSITY OF DAR ES SALAAM	TESTED BY:	B.Estomison
LOCATION:	BUMVA VILLAGE, SEGESE WARD	APPROVED BY:	F. Msafiri
TP ID:	BP 02 DEPTH (0.50 - 1.00) m	DATE:	13/04/2024

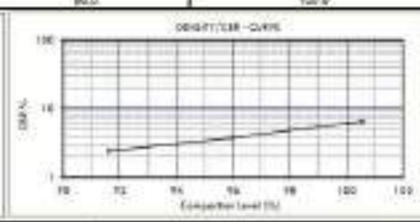
	Unit	A4	A5	A6
Natural Moisture Content (NMC) %	2.54	Water to be added (ICMC - NMC)/(100 + NMC)		300 mL
CBR Mould No.		A4	A5	A6
Compaction Effort		2.5 kg/3 layers/10 blows	2.5 kg/3 layers/30 blows	4.5 kg/5 layers/62 blows
Mass of Mould + Compacted Soil	g	11527	11484	11947
Mass of Empty Mould	g	7231	7273	7524
Mass of Compacted Soil	g	4296	4211	4423
Volume of Mould	cm³	2305	2305	2306
Bulk Density of Specimen	kg/m³	1742	1827	1919
Moisture Tin Number	No	K15	[illegible]	B1
Mass of Wet Soil + Tin	g	180.45	163.21	169.84
Mass of Dry Soil + Tin	g	158.55	132.75	148.38
Mass of Empty Tin	g	24.19	24.16	25.71
Mass of Water	g	21.90	19.36	20.49
Mass of Dry Soil	g	134.36	118.57	122.64
Moisture Content	%	16.30	16.41	16.71
Dry Density of Specimen	kg/m³	1498	1569	1644
Reference Data (MDD/OMC)		MDD 1634 kg/m³	OMC 17.1 %	
Gauge Reading on Soaking Day (R1)	mm	0.00	0.00	0.00
Gauge Reading after 4 days (R2)	mm	1.22	1.02	0.85
Swell Value [(R2-R1)/127]*100	%	0.96	0.80	0.67

CBR Tester No.: CT1 — Rate of Penetration: 1.27 mm/min — Ring Factor: 0.0107 kN/div

Penetration of Plunger (mm)	A4 Dial Gauge Reading (division) Top	A4 Bottom	A4 Force on Plunger (kN) Top	A4 Bottom	A5 Dial Gauge (division) Top	A5 Bottom	A5 Force on Plunger (kN) Top	A5 Bottom	A6 Dial Gauge Reading (division) Top	A6 Bottom	A6 Force on Plunger (kN) Top	A6 Bottom
0.00	0		0		0		0		0		0.00	
0.50	10		0.11		12		0.13		15		0.16	
1.00	15		0.16		22		0.24		27		0.29	
1.50	20		0.21		29		0.31		46		0.49	
2.00	25		0.27		36		0.39		60		0.64	
2.50	30		0.32		46		0.49		80		0.85	
3.00	35		0.37		54		0.58		105		1.12	
3.50	40		0.43		63		0.67		125		1.34	
4.00	45		0.48		72		0.77		149		1.60	
4.50	50		0.54		82		0.88		153		1.63	
5.00	55		0.59		93		0.98		165		1.77	
5.50	60		0.64		102		1.09		171		1.82	
6.00	64		0.69		112		1.20		180		1.93	
6.50	68		0.73		120		1.28		188		2.02	
7.00	70		0.75		127		1.36		200		2.15	
7.50	72		0.77		132		1.41		208		2.23	

CBR	A4 Top	A4 Bottom	A4 Corrected Value	A5 Top	A5 Bottom	A5 Corrected Value	A6 Top	A6 Bottom	A6 Corrected Value
At 2.5 mm (F = 13.2 kN)	2			4			6		
At 5.0 mm (F = 20.0 kN)	3			5			9		
Recorded CBR Value (%)	2			4			9		
Relative Compaction (%)	91.0			96.0			100.6		





REPORTED CBR	At 90 % MDD		At 93 % MDD	3	At 95 % MDD	3	At 98% MDD	5

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DEPARTMENT OF STRUCTURAL & CONSTRUCTION ENGINEERING

Our reference SCE 2024-157
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Dar es Salaam

UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS

Reference ASTM D7012-14

CLIENT: STATE MINING CORPORATION (STAMICO)

PROJECT: THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL - SCALE GOLD MINERS (ASGM) MERCURY - FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINGANYA REGION

SITE:	BUMVA SEGESE
Sample type	ROCK
Borehole ID	BH 2
Depth (m)	1.10 - 1.50
DATE	08/04/2024

SAMPLE CONDTION: DRY

Testing Results		**Sample Measurements**	
Max Load (KN)	47.6	Diameter (mm)	90
		Height (mm)	100
Stress (N/mm^2)	7.5	Area (mm^2)	6358.5
		Volume (m^3)	0.000636
Pace Rate (KN/Sec)	1.25	Mass (kg)	1.376
		Dry Density (kg/m^3)	2164.03

BEFORE TEST

Failure Mode	**Notes**
Type 4/2	Mode: (1) Diagonal Shear Plane(s) (2) Vertical Fracture(s) (3) Vertical Splitting (4) Shear along foliation/ discontinuity (5) Conical (6) Spalling (7) Other

AFTER TEST

Comments

Structures and Building Materials Laboratory

DATE: 08/04/2024

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Dar es Salaam

UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS

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SITE:	BUMVA SEGESE
Sample type	ROCK
Borehole ID	BH 2
Depth (m)	4.20 - 4.35
DATE	08/04/2024

SAMPLE CONDTION: DRY

Testing Results		**Sample Measurements**	
Max Load (KN)	18.0	Diameter (mm)	90
		Height (mm)	90
Stress (N/mm^2)	2.8	Area (mm^2)	6358.5
		Volume (m^3)	0.000572
Pace Rate (KN/Sec)	1.25	Mass (kg)	1.177
		Dry Density (kg/m^3)	2056.74

BEFORE TEST

Failure Mode	**Notes**
Type 4/2	**Mode:** (1) Diagonal Shear Plane(s) (2) Vertical Fracture(s) (3) Vertical Splitting (4) Shear along foliation/ discontinuity (5) Conical (6) Spalling (7) Other

AFTER TEST

Comments

Structures and Building Materials Laboratory

DATE: 08/04/2024

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UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE SPECIMENS — **Reference ASTM D7012-14**

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SITE:	BUMVA SEGESE
Sample type	ROCK
Borehole ID	BH 3
Depth (m)	1.00 - 1.20
DATE	08/04/2024

SAMPLE CONDTION: DRY

Testing Results		**Sample Measurements**	
Max Load (KN)	125.2	Diameter (mm)	110
		Height (mm)	110
Stress (N/mm²)	13.2	Area (mm²)	9498.5
		Volume (m³)	0.001045
Pace Rate (KN/Sec)	1.25	Mass (kg)	2.577
		Dry Density (kg/m³)	2466.42

Failure Mode	**Notes**
Type 4/2	**Mode:** (1) Diagonal Shear Plane(s) (2) Vertical Fracture(s) (3) Vertical Splitting (4) Shear along foliation/ discontinuity (5) Conical (6) Spalling (7) Other

BEFORE TEST

AFTER TEST

Comments

Structures and Building Materials Laboratory

DATE: 08/04/2024

UNIVERSITY OF DAR ES SALAAM

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TEST REPORT

PERMEABILTY TO WATER

ACCORDING TO BS EN 12390 - 8

CLIENT: STATE MINING CORPORATION (STAMICO)

CONSULTANT: UNIVERSITY OF DAR ES SALAAM

PROJECT: THE PROPOSED CONSTRUCTION AND OPERATION OF THE CIP/CIL PLANT FOR ARTISANAL SMALL - SCALE GOLD MINERS (ASGM) MERCURY - FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION

1. General

The Structures and Building Materials Laboratory casted 1 (ONE) samples of CORE Cylinder for the determination of water permeability tests according to BS EN 12390 - 8 (water permeability test)

2. Procedure

A core Cylinder of 100 mm diameter specimen is subjected to water pressure at one preliminary stage and three loading stages. The preliminary stage starts by loading the samples with 0.5 Bar or (0.05 N/mm2) water pressure to check the tightness between the sample , and testing equipment.

The first Loading stage starts by loading the sample with an Air and water pressure of 1.0 bar (0.1 N/mm^2) for the next 48 Hrs followed with a water pressure of 3 Bars (0.3N/mm^2)bars for last 48 Hrs.

The results are assessed by measuring the water penetration through the sample to the nearest 1 mm

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3. Test results

Table of Results

Date of test	Sample	Cylinder size		Water penetration	Max water pressure	Rate of water penetration
	Indication	diameter mm	Height mm	mm	bars	mm/sec
10/04/2024	ROCK (0.50 - 0.70 m) - BH 1	100	150	27.0	5	$1.04x10^{-4}$
Average water penetration of ROCK (0.50 - 0.70 m) - BH 1 samples				**27.0**	**$1.04x10^{-4}$**	

4. QUALIFICATION OF SAMPLE

samples had an average water penetration of 27 mm or $1.04x10^{-4}$ mm/sec for ROCK (0.50 - 0.70 m) - BH 1 samples

The samples falls in a range of AVERAGE PERMEABILITY

see Table Below

PERMEABILITY RATE	*CATEGORY SET BY BS EN 12390 - 8*
1.0x10[illegible] to 1.0x10[illegible] mm/sec	**AVERAGE PERMEABILITY**
1.0x10[illegible] to 1.0x10[illegible] mm/sec	LOW PERMEABILITY
1.0x10[illegible] to 1.0x10[illegible] mm/sec	HIGH IMPERMEABILITY

Structures and Building Materials Laboratory

Appendix XII: Hydrological Report

THE UNITED REPUBLIC OF TANZANIA

PROPOSED CONSTRUCTION AND OPERATION OF THE CIP PLANT FOR ARTISANAL SMALL-SCALE GOLD MINERS MERCURY-FREE GOLD PROCESSING DEMONSTRATION CENTRE AT BUMVA VILLAGE, SEGESE WARD, MSALALA DISTRICT IN SHINYANGA REGION

HYDROLOGICAL REPORT

DRAFT FINAL REPORT

Submitted by

University of Dar es Salaam College of
Engineering and Technology
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7th May 2024

TABLE OF CONTENTS

1.0 INTRODUCTION

The Government of the United Republic of Tanzania (URT) has received funds from the World Bank (WB) Global Environmental Facility (GEF) to undertake The Environmental Health and Pollution Management Project (EHPMP). The EHPMP is five years (July 2020– July 2025) regional project covering Tanzania, Kenya, Zambia, Senegal, and Ghana which aims to strengthen the institutional capacity to manage and regulate mercury use in Artisanal and Small-scale Gold Mining (ASGM) in the participating countries. ASGM uses mercury in gold recovery in a manner that is dangerous to human health and the environment because amalgamation is done with bare hands and the amalgam is heated in open air to drive away the mercury. Furthermore, in ASGM for every 1 kg of gold recovered, about 2 kg of mercury is used and most of it is released into the environment. In response, the URT government, through EHPMP intends to establish ASGM demonstration centers in the ASGM areas, including Msalala District in Shinyanga Region for which it has mandated University of Dar es salaam (UDSM) to develop a Carbon in Pulp (CIP) Plant for ASGM mercury-free gold processing demonstration centre at Bumva Village in Segese Ward of Msalala District in Shinyanga Region.

The objective of a detailed hydrological study is to comprehensively assess the potential impacts of the proposed project on water resources and to develop strategies to minimize adverse effects and ensure sustainable management of water resources. Assessment of Water Resources, evaluates the availability and quality of surface water and groundwater resources in the project area, whereby it helps in understanding the baseline conditions and potential impacts of the proposed project on water availability. It examines the potential for flooding in the project area, considering factors such as topography, land use, and existing drainage patterns. Understanding flood risks is crucial for designing appropriate measures to mitigate potential impacts on the project and surrounding areas. The study also analyzes the quality of surface water and groundwater, identifying any pollutants or contaminants present. This assessment is essential for determining potential risks to human health and the environment and for developing strategies to manage and mitigate water pollution. It evaluates the potential impacts of the proposed project on water resources, including changes in water quantity, quality, and hydrological processes which helps in identifying potential adverse effects and designing appropriate mitigation measures to minimize negative impacts. Based on the assessment of potential impacts, the study recommends mitigation and management measures to minimize adverse effects on water resources. These measures may include stormwater management techniques, erosion control measures, groundwater monitoring programs, and measures to protect sensitive aquatic habitats. The detailed hydrological study ensures compliance with regulatory requirements related to water resources management and environmental protection. It provides the necessary data and analysis to support the permitting process and demonstrates that the proposed project meets applicable standards and regulations.

2.0 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

2.1 CLIMATIC CONDITION

2.1.1 Temperature

Temperature is relatively constant throughout the year with mean daily temperature ranging from 21 ^{0}C to 26 ^{0}C. Average annual temperature is 21.3 ^{0}C and the hottest month is in July while the coldest weather is in December. The site has a temperate climate with average temperatures ranging from 11°C to 30°C (Bishanga, 2023).

2.1.2 Rainfall

Rainfall in the Council starts in late October to early May. The rainy season is characterized by two- weeks to one –month dry spells, being most pronounced in January and February (COUNCIL, 2022). The average annual rainfall ranges between 750 and 1030 mm. Regional wise, the average annual rainfall of about 999 mm with average of 6 mm (0.2 in) of rainfall (precipitation) (Bishanga, 2023).

2.2 Topography

Msalala DC is dominated by extensive plains, gently undulating plain and flat plains which cover almost 80% of the area while 13% is valley dominated and 7% is hilly area. Generally, the council lies between 345 and 958 meters above sea level where Chella hills are the highest point in the Council.

2.3 Soil Type(s)

The geology of the study area (Gold Processing Plant) comprises sequences of dominantly mafic volcanic rocks and immature sedimentary rocks, which forms the greenstone belt of Tanzania Craton surrounded by granites.

These sequences are subdivided into a Lower and an Upper series on the basis of recognizable upward transition from mafic to felsic lavas, with minor tuffs and interbedded sedimentary rocks. The Lower series consists primarily of basalt, andesite and dacite pillow lavas. The sedimentary rocks include banded iron formation (BIF), recrystallized cherts, and some shale and conglomerate. The specific surveyed area composed of reddish silt and granitic soil, which is a result of weathering of mafic Volcanic and unconsolidated superficial deposits (Bishanga, 2023).

3.0 HYDROLOGY

3.1 Water Resources

Generally, the Council and project site particularly is dry with limited water resources. The District and project site generally, there is neither major river nor Lakes and dams. The nature of drainage system of the district and the Segese ward falls under the areas draining the water to the Lake Tanganyika. Therefore, the project site is served by Lake Tanganyika Basin Water Board Office (LTBWB). Underground water is the main water resources for the community living in Msalala district council and the project site in particular.

3.2 Soil Erosion Potential

Experience with mining operations reveals possibility of occurrence of the soil erosion from the stock pile of the ore materials. The proposed site lacks drainage structures. The major types of soil erosion at the project site include sheet erosion, rill erosion, gullies erosion and ravines. Usually, the top soil is removed more or less evenly with regard to sheet erosion. As sheet erosion focuses on small channels, may led to rill erosion formations. When the volume is concentrated further, running water erode deeper into the soil, and the rills become larger channels known as gullies. As gullies expand and deepen, they form a large feature of soil erosion which is called ravine. The survey shows that the storm water that flows through the rills turns the waterways into gullies. Soil erosion possesses high risk in formation of gullies but also pollution of the downstream water resources from the eroded materials containing unwanted chemicals or minerals.

The establishment of Gold processing project may increase soil erosion if effective conservation measures and proper storm water management methods are not adopted. It is probable that the slopes and the erosion will continue to grow, and multiple gullies erosions may merge into one very wide valley which will not influence the other development activities at the Gold Processing site.

3.3 Possibility of Water Resources Pollution

Nature of the small miners' operation is generally unsafe due to limited knowledge, quality of the equipment's used, Method of mining activities and low capital. Mining activities normally are chemical oriented during Gold Processing and also the mining activities expose the mineral ore containing harmful pollutants to the environment. The mining waste when not well management is normally may react with air or water and form harmful product to the environment and people. Sometimes the wastes are transported by the run off during rain period and cause siltation and other pollution issues to the receiving water bodies.

The proposed Gold processing should take into account proper management of the waste management and raw materials handling in order to protect the downstream and underground water pollution from the mercury (Hg), Siltation, High water turbidity, pH, Water hardness, Arsenic, iron, fluoride, aluminum (Al), Manganese, Cyanide etc

Near the project site there are no major water bodies, but occurrence of stormwater runoff to the Lake Tanganyika possess high risks of water pollution and public health if proper liquid and solid waste are not adhered.

3.4 Water Supply and Treatment Services

Water supply service at the District is mainly provided by RUWASA. The District is getting water from a number of sources as outlined below;

- Borehole
- Shallow well
- Springs
- Charcoal dams
- Pipeline from Lake Victoria

The main water sources used in the project site located at the Bumva Village, Segese Ward in Msalala District council are the shallow wells and springs.

3.5 Water Quality Status

Shallow wells water sources are characterized of high turbidity as shown in figure 1 below because they are not well protected from runoff and also other pollution from the human operations. Drilling of boreholes and Rainwater harvesting alternatives are the possible and feasible intervention to be part and parcel of this proposed project in Bumva village (project site). The figure 1 below shows shallow well proximity to the project site.

Figure 1: Example of the Shallow Well Proximity to the Project Site at Bumva Village, Segese Ward

Water samples were taken at the individual shallow well (figure 1) and community shallow well (figure 2) at Bumva village and the results are as shown in Table 2 below.

Table 1. Water Quality Status at the Community Shallow Well

Parameter	Sampling Points/Locations		Standard	Method
	Sample Community 1	Segese Sample Community 2	TZS 860:2019	
Mercury (mg/l)	<0.0010	<0.0010	0.001	Metalyser HM3000 (Stripping Voltammetry technique)
Arsenic (mg/l)	<0.0010	0.0010	0.01	
Copper (mg/l)	<0.01296	<0.0010	0.5	
KEY				
	Fail		Pass	

Figure 2: Example of the Community Shallow Well Proximity to the Project Site at Bumva Village

There is a lot of small mining operation proximity to the project site and the ward in general. Nature of operation of the small miners in not safe for the environment and therefore relying on the water from shallow wells poses high health risks and safety to the consumers. The Gold processing activities also need water with good quality (drinkable water) during gold processing and therefore the issue of having reliable and safe water is of paramount important.

Water supplied at the council covers only 46% of the District council population. RUWASA face a number of challenges to reach the intended water supply demand as outlines below;

- Limitation of Budget to construct water supply infrastructure
- Dry out to some water sources during the dry season especially shallow wells
- Some areas with aquifers of low water discharge

The proposed project on its design should consider design of an alternative water supply sources for its sustainable operations. Water quality issues is also of great concerns, there is no complete water treatment systems on the water supply schemes at the area. Shallow wells are characterized of high turbidity as shown in figure 1 and 2 above because they are not well protected from runoff and also other pollution from the human operations. Drilling of boreholes and Rainwater harvesting alternatives are the possible and feasible intervention to be part and parcel of this proposed project in Bumva village, Segese Ward.

4.0 STORMWATER MANAGEMENT

Stormwater Management

The project site does not have a storm-water management facility. The possibility of storm-water generation is high and therefore the management aspect for storm-water should be considered. The constructions of the storm-water drainage channels and storm-water management ponds/ rainwater harvesting ponds are examples of storm-water management interventions. Table 2 below shows the estimates of the quantity of the storm-water generation per year at the proposed project site.

Table 2: Types, amounts and treatment/disposal of wastes during the operation phase

Waste	Types	Amount	Treatment/ Disposal
Storm water	Runoff	Based on an average of 20% paved project area and 80% unpaved project area; the estimated runoff (m^3/year) = K×I×A Where by K =Runoff coefficient (0.85 for paved surface and 0.7 for unpaved surface) I= Rainfall Intensity (1100mm) A = Area of the catchment (m^2) =(0.85*0.2*1.1*32,375)+(0.7*0.8*1.1*32,375) Strom-water generation per year for 8acres of the project site =26,000 m^3/year	To be directed to storm-water drainage system present to be constructed Rainwater harvesting Pond/Dam

5.0 STAKEHOLDER ENGAGEMENT

Stakeholder consultation and involvement is a process through which different key stakeholders influence and share their views regarding development initiatives and the decisions and resources that affect them. The participation of different social groups directly affected by a project or could impact the project is a prerequisite of any project planning. Section 89 of the Environmental Management Act (EMA, 2004) provides directives on public participation in any EIA process.

5.1 IDENTIFICATION OF STAKEHOLDERS

Stakeholders' identification was based on the role and relevance of an organization, group or individual to the proposed project. Most of the stakeholders that might be impacted by the project e.g. the neighbourhood of the project site, local government authorities and district office were pre-determined, while others were unfolded as the consultations went along. Identified stakeholders include Msalala District Council (MDC) Executive Director, MDC's relevant officials and head of departments including Public Health and Environment, Land, and Urban Planning. Other stakeholders include RUWASA, Lake Tanganyika Basin Water Board Office (LTBWB),

5.2 INVOLVEMENT AND ENGAGEMENT OF STAKEHOLDERS

The consultant ensured that all key stakeholders were given adequate opportunity to participate in the scoping study. Different participatory methods were used. These include:

- Consultative meetings at regional, district and local levels;
- Interviews and group or one-to-one discussions with individual stakeholder;
- Interviews with key informants;
- Field assessments of project site

The figures 3 below show the project team with different stakeholders. Views and concerns raised by the stakeholders are summarized in the table 3 below;

Consultation with the Lake Tanganyika Basin Water Board Office	Consultation with RUWASA on Water Supply Service level

Figures 3: Project Team with Different Stakeholders at Kahama District

Table: 3 List of Stakeholders Consulted, their Views and Concerns a, the Rate of Interest in the Project and Provided Response

Authority/Stakeholders Consulted	**Role of the stakeholder**	**Issues Raised**	**Rate of Interest**	**Response Section on issues raised**
Lake Tanganyika Basin Water Board Office (LTBWB)	It statutory and regulatory organization that oversees Water resources management	1. Water abstraction permit is provided by the LTBWB 2. The Gold processing plant must have a proper waste management facility in place and the discharge permit is provided by the LTBWB after satisfactory pre-treatment and meet the required quality for discharge 3. Ensure regular effluent quality monitoring 4. Ensure to establish monitoring borehole for pollution control	**High**	1. Noted for compliance 2. Noted for compliance 3. To be adhered during operation phase 4. Noted for compliance
RUWASA	Sorely mandated for water supply in Rural areas	1. Gold mining activities often involve the use of chemicals such as cyanide which can contaminate water sources. The concern was on potential water quality degradation and the impact on drinking water supplies for rural communities. 2. Mining activities can disturb soil and lead to erosion, contributing to sedimentation in nearby water bodies. This can degrade water quality, disrupt aquatic ecosystems, and impact the	**High**	1. Noted for compliance 2. Noted for compliance

Authority/Stakeholders Consulted	Role of the stakeholder	Issues Raised	Rate of Interest	Response Section on issues raised
		availability of clean water for rural communities.		

6.0 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF ALTERNATIVES

6.1 # Construction Phase Activities

6.1.1 Environmental Impact

6.1.1.1 Potential for Surface and Groundwater Pollution

The potential for surface and groundwater pollution results from the generation of dust and possible oil and fuel leaks during construction activities. The leaking oils and fuels may seep into the ground and hence contaminate groundwater. In addition, storm-water contaminated with leaking oils and fuels may lead to contaminate groundwater. In addition, storm water contaminated with leaking oils and fuels may lead to contamination of the surface water sources downstream. However, experience in water management that has been gained over the years makes the significance of this impact limited. *This impact is considered direct, medium-term, adverse, reversible and moderate significance.*

6.1.1.2 Erosion of Exposed Surfaces

Inadequate compaction and resurfacing compounded by rain, trampling, vegetation clearance etc. may cause erosion and consequent sediment load in runoffs. This is mostly likely to happen if construction is undertaken during the rain seasons. This impact is moderate, localized and will be long term.

6.2 #Impacts Associated with Operation Phase

6.2.1 Potential Pollution of Soils, Surface and Underground Water from Spills

Cyanide releases during transportation are infrequent, but occur in the mining industries. Such releases may lead to contamination of soils, surface and underground water. The exposure of human to cyanide spilled during transportation is one of the major risk scenarios with respect to cyanide use in mining. Contamination of surface water may lead to destruction of aquatic life, birds, and animals. In underground water, cyanide may lead to increased soluble heavy metals. However, the transportation of cyanide from the suppliers to Segese (the project site) will be carried by team of experienced transporters. This measure has been undertaken over the last eighteen years of transportation of cyanide to the mining sites such as GGM and have ensured that there is no incident of cyanide spillage during transportation. *This impact is considered direct, long-term, adverse, irreversible and of moderate significance.*

6.2.2 Potential for Contamination of Surface and Underground Water from Spillage and Seepage

Any spillage of cyanide may be washed down by stormwater to end up in surface water sources. However, handling of cyanide with the processing plant will be carried out in designated areas where all the spills can be contained within the plant area. Potential areas for spillage would include the bursting of the pipes, and therefore the trench hosting the pipes should be lined with geo-membrane liner and should be provided with sedimentation traps for collecting such spills. Storm water falling on the TSF surface has the potential to carry with it cyanide containing sediments and hence contaminate surface water sources downstream. Provision of an emergence spillway will however be provided below crest level to ensure that water can be discharged in a controlled manner in the event of extreme wet conditions. Since the plant is an engineered facility the concentration of the cyanide in the tailings leaving the CIL will be very low to have impact in the ground water. The allowed WAD cyanide concentration according to the Mining Environmental Standards is 0.5mg/l (Maximum Permissible concentration). *This impact is considered indirect, long-term, adverse, irreversible and of moderate significance*

6.2.3 Increased Storm Water Generation and Overflow

The proposed project components will generate 6,054 m^3/year of storm water due to the presence pavements, concrete surfaces and building roofs. The project will contribute 24% of the current storm water generation (24,923m^3/year). The structures will tend to compromise the infiltration capacity of the land surface hence causing surface runoff to increase. The impact of storm water generation will be aggravated due to nature of the topography of the project site. The storm water generated might have impacts on structures downstream as well as being a causative factor for soil erosion and poor water quality. *This impact is moderate, local and will be long term.*

7.0 CONTRIBUTIONS TO ANALYSIS OF PROJECT ALTERNATIVES

7.1 Water Supply Alternative

7.1.1 Alternative One: Water Supply (surface water) from the Operating Water Utility Company

Water supply from RUWASA is the option considered to be appropriate as the water supply network is within the village of the project site. Based on the field visit and stakeholder consultation, the water supply is currently not reliable, not clean and safe water supply to the proposed project.

7.1.2 Alternative Two: Groundwater Extraction

Stakeholders and documentary review suggest that underground water is another alternative option for water supply and can supplement the water supply at the project site at such times of water shortage and scarcity. It has to be noted that before establishing the groundwater as sources of water supply, an investigation in terms of groundwater quantity and quality has to be thoroughly carried out and ascertained. Ground water investigation and well drilling have cost implications on the project. Further, based on water quality observed on the nearby shallow well, utilization of ground water will necessitate investing on water treatment plant/equipment.

7.1.3 Alternative Three: Rainwater Harvesting

The project considered rainwater-harvesting potential as alternative source of water. It is proposed to harvest rainwater from both roof and land catchment. It will entail the design of rainwater harvesting system and underground water storage tanks. Although this may demand more investment (capital), its operation costs are relatively low. Rainwater harvesting is one of the best ways to reducing surface runoff and soil erosion.

7.2 Liquid Waste Management Alternatives

Five alternatives were considered for liquid waste management, namely stabilization ponds/lagoons; constructed treatment wetland; septic tank - soakaway system for the domestic wastewater; and TSF for mineral processing plant.

8.0 ENVIRONMENTAL MITIGATION AND ENHANCEMENT MEASURES

8.1 # Construction Phase Activities

8.1.1 Environmental Impact

8.1.1.1 Potential for Surface and Groundwater Pollution

Several measures shall be put in place to mitigate the impacts that are likely to lead to water quality degradation. The proponent will control the dangers of oil, grease and fuel spills during construction by maintaining the machinery in specific areas designed for this purpose. Machinery site repair will be discouraged and repair work restricted to only the approved garages to avoid pollution from oil, grease and fuel.

8.1.1.2 Erosion of Exposed Surfaces

Only the area required for construction purpose will be cleared. In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works.

Another point will be at reducing disturbance of vegetation in the project area. Individual trees within the project site will be preserved. The proponent has committed itself to re vegetation of some of the disturbed areas through implementation of a well-designed landscaping programme. Part of the topsoil excavated from the construction site will be re-spread in areas to be landscaped to enhance plant health.

8.2 #Impacts Associated with Operation Phase

8.2.1 Potential Pollution of Soils, Surface and Underground Water from Spills

- The TSF maximum operating water level will be set such the storage facility can completely contain a probable maximum precipitation event without risk of overtopping the tailings dam;
- Procedure for regular monitoring and ensuring that maximum operating water level of the TSF return water dam is not exceeded, including, if necessary, shutting down the mill and developing and implementing a plan to reduce the tailings storage facility water inventory will be instituted;
- Procedure for continuous monitoring to ensure that the cyanide concentration of the tailings slurry entering the tailings storage facility does not exceed 20ppm cyanide (total) on daily average basis will be implemented.
- Analysis of the water samples results will be carried out continuously in order to establish and changes in the cyanide and heavy metal concentrations and hence establish potential for seepage;
- Remedial measures where potential for seepage has detected will be taken in order to stop continuation of such seepage. Remedial will include treatment of the strata, e.g., through grouting, relocation of the facility, construction of lined storage facility i.e with geomembrane, treatment of the floor with clay later and other means. Any such detected seepage will be reported to the authorities;
- Continuous monitoring and testing of water samples downstream from the tailings storage facility and all water storage ponds will be undertaken as a way of controlling and potential for seepage;
- All equipment and facilities with potential for cyanide spillage will be bunded and provided with containment;
- The tailings pipeline will be provided with spill protection systems consisting of containment ditches and spill collection ponds that are synthetically lined to provide secondary containment and minimize the potential for an uncontrolled release to the environment. The spill collection ponds will be sized to contain a spill for the entire duration between visual inspections;
- The constructed containment ditches will be graded to direct spills from pipeline ruptures towards spill collection ponds or other appropriate containment;
- The tailing pipeline will be continuously monitored by different flow monitoring systems to allow for the immediate notification of the operators in the event of a spill;
- Daily visual inspection of the tailings pipeline will be carried out to complement the differential flow monitoring systems;

8.2.2 Potential for Contamination of Surface and Underground Water from Spillage and Seepage

In order to mitigate the potential impacts that may arise as a result of spillage and seepage of cyanide the following measure are proposed;

- Adequate containment and bunding will be provided to ensure that cyanide is contained within the site and prevent the drainage of accidental spilled cyanide to the environment from CIL/CIP processing and cyanide storage facilities
- Tailings storage facility, the run-off trench from the TSF to the sediment pond, tailings dam sedimentation pond and return water pond surface will be lined by impervious geo-membrane or treatment of the floor with clay;
- Procedure for continuous monitoring to ensure that the cyanide concentration of the tailings slurry entering the tailings storage facility does not exceed 20ppm cyanide (total) on daily average basis will be implemented.
- Monitoring of seepage of cyanide and associated compounds from the TSF system will be established using the drilled boreholes. Where the potential for seepage is detected appropriate remedial measures such as relocation and collection of seepage and recycling will be taken in order to stop the continuation of such seepage
-

8.2.3 Increased Storm Water Generation and Overflow

- Proper sizing and construction of the stormwater drainage channels
- Establishment of the rainwater harvesting systems
- Proper sizing of the TSF and provision of the freeboard to take care of the increase flow from rainfall events.

9.0 ENVIRONMENTAL AND SOCIAL IMPACT MANAGEMENT PLAN

Table: 4 Environmental Management Plan for the Proposed Project Undertakings

Identified Impact	**Mitigation Measure**	**Responsible Institution**	**Relative cost (TZS)**
Construction Phase			
Potential for Surface and groundwater pollution	• Several measures shall be put in place to mitigate the impacts that are likely to lead to water quality degradation. The proponent will control the dangers of oil, grease and fuel spills during construction by maintaining the machinery in specific areas designed for this purpose. Machinery site repair will be discouraged and repair work restricted to only the approved garages to avoid pollution from oil, grease and fuel.	Client/Contractor	5,000,000
Erosion of Exposed Surfaces	• Only the area required for construction purpose will be cleared. • Limit construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works. • Another point will be at reducing disturbance of vegetation in the project area. • Individual trees within the project site will be preserved. • The proponent has committed itself to re vegetation of some of the disturbed areas through implementation of a well-designed landscaping programme. • Part of the topsoil excavated from the construction site will be re-spread in areas to be landscaped to enhance plant health.	Client/Contractor	3,000,000
Operation Phase			

Identified Impact	Mitigation Measure	Responsible Institution	Relative cost (TZS)
Potential Pollution of soils, surface and underground water from spills	• The TSF maximum operating water level will be set such the storage facility can completely contain a probable maximum precipitation event without risk of overtopping the tailings dam; • Procedure for regular monitoring and ensuring that maximum operating water level of the TSF return water dam is not exceeded, including, if necessary, shutting down the mill and developing and implementing a plan to reduce the tailings storage facility water inventory will be instituted; • Procedure for continuous monitoring to ensure that the cyanide concentration of the tailings slurry entering the tailings storage facility does not exceed 20ppm cyanide (total) on daily average basis will be implemented. • Analysis of the water samples results will be carried out continuously in order to establish and changes in the cyanide and heavy metal concentrations and hence establish potential for seepage; • Remedial measures where potential for seepage has detected will be taken in order to stop continuation of such seepage. Remedial will include treatment of the strata, e.g., through grouting, relocation of the facility, construction of lined storage facility i.e with geomembrane, treatment of the floor with clay later and other means. Any such detected seepage will be reported to the authorities; • Continuous monitoring and testing of water samples downstream from the tailings storage facility and all water storage ponds will be undertaken as a way of controlling and potential for seepage;	Client	100,000,000

Identified Impact	Mitigation Measure	Responsible Institution	Relative cost (TZS)
	• All equipment and facilities with potential for cyanide spillage will be bunded and provided with containment; • The tailings pipeline will be provided with spill protection systems consisting of containment ditches and spill collection ponds that are synthetically lined to provide secondary containment and minimize the potential for an uncontrolled release to the environment. The spill collection ponds will be sized to contain a spill for the entire duration between visual inspections; • The constructed containment ditches will be graded to direct spills from pipeline ruptures towards spill collection ponds or other appropriate containment; • The tailing pipeline will be continuously monitored by different flow monitoring systems to allow for the immediate notification of the operators in the event of a spill; • Daily visual inspection of the tailings pipeline will be carried out to complement the differential flow monitoring systems;		
Potential for contamination of surface and underground water from spillage and seepage	• Adequate containment and bunding will be provided to ensure that cyanide is contained within the site and prevent the drainage of accidental spilled cyanide to the environment from CIL/CIP processing and cyanide storage facilities • Tailings storage facility, the run-off trench from the TSF to the sediment pond, tailings dam sedimentation pond and return water pond surface will be linad by impervious geo-membrane or treatment of the floor with clay; • Procedure for continuous monitoring to ensure that the cyanide concentration of the tailings slurry entering the tailings storage	Client	100,000,000

Identified Impact	Mitigation Measure	Responsible Institution	Relative cost (TZS)
	facility does not exceed 20ppm cyanide (total) on daily average basis will be implemented. • Monitoring of seepage of cyanide and associated compounds from the TSF system will be established using the drilled boreholes. Where the potential for seepage is detected appropriate remedial measures such as relocation and collection of seepage and recycling will be taken in order to stop the continuation of such seepage •		
Storm-water generation and Overflows	• The design storm water drainage will be given a high priority, with the limitation of gradient (slope) • Proper hydrology analysis will be carried out, considering the topographical features, amount of rainfall and catchments area as the major factors of design of storm water channel. Channel with the capacity of accommodating the amount of water found will be provided/designed. • Rainwater harvesting will be used at the project site • The design shall consider enough greeneries in the project site	Client	15,000,000

10.0 ENVIRONMENTAL AND SOCIAL IMPACT MONITORING PLAN

Table: 5 Environmental Monitoring Plan fThe Proposed Project Undertakings

Identified Impact	Monitoring parameter	Monitoring frequency	Sampling area	Measureme nt Unit	Target Level/ Standard	Responsibility	Relative cost (TZS)
Construction Phase							
Potential for Surface and groundwater pollution	Suspended solids in water, Oil content in slime channels	Quarterly per year	Project area	Mg/l and ppm	WHO, TBS	Client/Contractor	5,000,000
Erosion of Exposed Surfaces	Formation of gullies/ erosion	Daily basis	Project area			Client/Contractor	3,000,000
Operation Phase							
Potential Pollution of soils, surface and underground water from spills	Suspended solids in water, water quality parameters	Quarterly per year		Mg/l	WHO, TBS	Client	8,000,000
Potential for contamination of surface and underground water from spillage and seepage	Water Quality	Weekly during wet season	All project areas	Mg/l	WHO, TBS	Client	15,000,000

Identified Impact	Monitoring parameter	Monitoring frequency	Sampling area	Measurement Unit	Target Level/ Standard	Responsibility	Relative cost (TZS)
Storm-water generation and Overflows	Overflows	Daily	All project areas			Client	5,000,000

Bibliography

Bishanga, E. R. (2023). *Hydrological and Hydrogeological Study for Mwamanga Co. Ltd at Bulige Village Msalala Council in.*

COUNCIL, M. D. (2022). *MSALALA DISTRICT COUNCIL STRATEGIC PLAN (2018/2019- 2022/2023).*

CONTRIBUTION TO PROJECT DESCRIPTION

TAILINGS DISPOSAL

This component is affected by the rainfall events which are part of the hydrology and therefore the following description is recommended to be included in the project description part of the Tailings disposal.

Tailings Dam Design

Drainage and Solution Control

Penstock construction and Operation

Level Indicator

Poles will be placed in the paddocks and painted at 1m intervals that will be at the same level. This will indicate the level of slime around the perimeter of the slimes dam and will indicate any low spots for attention.

Internal Water Monitoring

Piezometer pipes will be installed on each side for monitoring the level of water around the outer edge of the facility. This will indicate if there is an internal problem so that action can be taken in the form of an internal drain.

Monitoring Boreholes

Reasonable monitoring boreholes are being recommended for this facility to monitor seepage for both TSF facilities (existing and proposed TSF). These boreholes will be used for detection of any possible contamination both before the facility and after. A comprehensive monitoring program will be developed in order to check seepage into groundwater be incorporated in the Operation and Surveillance Manual. The borehole shall only be used for regular underground water quality monitoring.