Irrigation Development Support Project (IDSP)
Ministry of Agriculture
Government of the Republic of Zambia

Environmental and Social Management Plan

Irrigation Development Support Project (IDSP) Remedial Works

Remedial Works on Chikowa Dam

12 January 2022

Prepared by UNOPS for the Government of the Republic of Zambia

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LIST OF ACRONYMS AND ABBREVIATIONS

AF	Additional Financing
AR	Activity Rate
BDA	Biodiversity Assessment
BMP	Biodiversity Management Plan
CoC	Code of Conduct
COVID-19	Corona Virus Disease 2019
CpUE	Catch per Unit Effort
Dbh	Diameter at breast height
DMC	Dam Management Committee
DMMU	Disaster Management and Mitigation Unit
DWRD	Department of Water Resources Development, previously Department of Water Affairs, WRDP implementer
E&S	Environmental and Social
EIA	Environmental Impact Assessment
EPB	Environmental Project Brief
EPP	Emergency Preparedness Plan
ESA	Environmental and Social Audit
ESMP	Environmental and Social Management Plan
ESSAT	Environmental and Social Standards Advisory Team
EPBs	Environmental Project Briefs
FAO	Food and Agriculture Organization of the United Nations
fsl	Full Surface Level
GBV	Gender Based Violence
GPS	Geographical Positioning System
GRM	Grievance Redress Mechanism
GRZ	Government of the Republic of Zambia
HSSE	Health Safety Social and Environmental
IBAT	Integrated Biodiversity Assessment Tool
ICOLD	International Commission on Large Dams
IDA	International Development Agency
IDSP	Irrigation Development Support Project
IDSP AF	Irrigation Development Support Project Additional Financing
ILO	International Labor Organization
ISDS	Integrated Safeguard Data Sheet (World Bank)
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
KBA	Key Biodiversity Area

LMP	Labor Management Plan
MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
NWFP	Non-wood Forest Products
msl	mean sea level
NGO	Non-governmental Organization
ODI	Overseas Development Institute
OP	Operational Policy
OPCS	Operational Policy and Country Services
PAD	Project Appraisal Document
PAP	Project Affected Person
PDO	Project Development Objective
PGA	Peak Ground Acceleration
PSU	Primary Sampling Unit
PIU	Project Implementing Unit
SEF	Safety Evaluation Flood
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SF	Sampled fishers
SI	Shannon Diversity Index
SMN	Sampled Catch
SP	Sampling Points
Sp	Species
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNOPS	United Nations Office for Project Services
USD	United States Dollar
VIP	Ventilated Improved Pit
VSU	Victim Support Unit
WARMA	Water Resources Management Authority
WRDP	Water Resources Development Project
YWCA	Young Women Christian Associates
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZMD	Zambia Meteorological Department

Executive Summary

Chikowa Dam is located in Mambwe District of the Eastern Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank funded Irrigation Development Support Project (IDSP), The IDSP is implemented by the Ministry of Agriculture and has been effective since 2011. The dam was constructed under the Water Resources Development Project (WDRP) in 2018. The main purpose of the dam is to provide water for irrigation as well as livestock, domestic purposes, recreational purposes, aquaculture and fishing for the communities of Chikowa. The dam is classified as a small dam, although it is large in regards to the spillway, and it has a large catchment carrying a potentially high load of sediment. It has a requirement for a non-erodible spillway.

The WDRP was classified as a 'Category B' project under the World Bank safeguards policies, and it triggered several operational policies (OPs) in relation to the dam construction. However, the World Bank's mid-term review of the WRDP identified non-compliance issues with safeguards policies and poor quality of the construction works at the dam. Despite efforts to bring the project back on track, the project continued to remain out of safeguards compliance. The WDRP was closed in 2018.

The World Bank has provided Additional Financing (AF) to the IDSP, to support remedial works on 10 of the dams constructed or rehabilitated by WRDP, including Chikowa Dam. The United Nations Office for Project Services (UNOPS) is tasked with overseeing the works and with the preparation of this Environmental and Social Management Plan (ESMP) and Biodiversity Management Plan (BMP), on behalf of the Government of the Republic of Zambia. The BMP was prepared as a separate report and annexed to this ESMP, following a biodiversity assessment of the respective dam. The objectives of this ESMP read together with the BMP are to guide the remedial works on the dam, mitigate imminent identified risks to the environment, safety of communities and their associated livelihoods, and to bring the dam in compliance with World Bank safeguards policies.

The key structural legacy issues of the Chikowa Dam include the following (towards the northern end as one approaches the spillway):

a) Crest tension cracks on "un-engineered embankment", probably due to settlement of the embankment fill caused by sponging and seepage along the toe of the dam.
b) Erosion of the top layer concrete of the spillway
c) Seepage occurring in-between the masonry crest and the concrete structure of the spillway. This was also observed around the left abutment of the spillway structure.
d) Spillway possibly inadequate to cater for large flows
e) Flood erosion of the spillway return, throwing flow to the left and causing vertical slopes of 4–6 m.
f) All eroded slopes (training wall) to the channel are unstable.

The key non-structural legacy of the dam include the following:

a) Rehabilitation of the borrow pit site
b) Restoration of access routes to the borrow pit

UNOPS is in the process of completing a detailed design for the remedial works on Chikowa Dam. The works may change the nature and scope of the existing dam operation activities, if it is decided that the

emergency spillway is included in the remedial works. The works will be implemented in two ways: construction and demobilization activities and the existing sites' remediation activities.

Institutional Arrangements: The sub-project works on Chikowa Dam will be managed and implemented by the Ministry of Agriculture of Zambia, under the IDSP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the IDSP-PIU of the IDSP will manage and implement the broader Additional Financing (AF) activities, it has contracted UNOPS to oversee and implement the remediation works on ten dams, including the Chikowa Dam. UNOPS will procure and oversee a contractor for the remedial works on the dam.

The dam community is expected to own this sub-project and report any grievance or misconduct by the contractor or its personnel to the IDSP-PIU through the Project AF Grievance Redress Mechanism (GRM). Upon completion of the works, the management, operation and maintenance of the dam will therefore be handed over to the Chikowa Dam Management Committee (DMC). In order to successfully operate the dam, and limit negative impacts on people and environment, the DMC members and community members will receive capacity building and training.

The ESMP addresses the environmental and social risks and impacts, which were identified through extensive field assessments. It includes a construction works management plan with mitigation measures and performance indicators for non-hazardous waste; hazardous waste; soil; land use and aesthetics; surface and groundwater pollution; air quality and noise; sanitation; traffic; biodiversity assessment and management plan; community health and safety; gender equality and Gender Based Violence (GBV); labor and working conditions; decommissioning and rehabilitation measures; and maintenance and monitoring.

A separate rehabilitation and remediation plan will be prepared design of the works have been decided on to address the non-compliance structural and non-structural legacies. This is critical to provide guidance during the rehabilitation and remediation of the existing and previous dam construction areas which may have the following;

a) environmental and safety issues;
b) existing but incomplete dam construction works and sites to enable completion;
c) need to outline the requirements to return previously disturbed sites to a state which is similar to the state prior to construction.

Social concerns include the failure to stock the dam with fish posing risks of food insecurity, and a lack of capacity / training for community members to benefit fully from irrigation water supply. In regards to the latter, the communities require robust sensitization to encourage them to conduct agricultural activities.

This ESMP further includes a capacity building and training plan that lays out necessary training for DMC members, community members, and other stakeholders in relation to the construction and operation phase of the planned works at Chikowa Dam. Similarly, a stakeholder engagement plan lays out the detailed modes of engagement with a variety of stakeholders in order to ensure appropriate dissemination of all necessary information regarding the works; and to allow for the consultation of stakeholders on dam-related environmental and social issues.

1. Introduction

Chikowa Dam is located about 15 km southeast of the Mambwe District Administrative Centre, and 3 km from the Chikowa Mission in the Chikowa Ward, Eastern Province. It is located on the non-perennial Kasenengwa River. The site is about 98 km northwest of Chipata City and about 66 km from Mfuwe. The district has a surface area of about 4,840km^2 and is located between latitude 13.30 degrees north and 14.45 degrees South, and longitude 31 and 32 degrees east. It is approximately 700km east of Zambia's capital city Lusaka – and borders Lundazi District to the north, Mpika to the northwest, Serenje to the west and Petauke to the southwest.

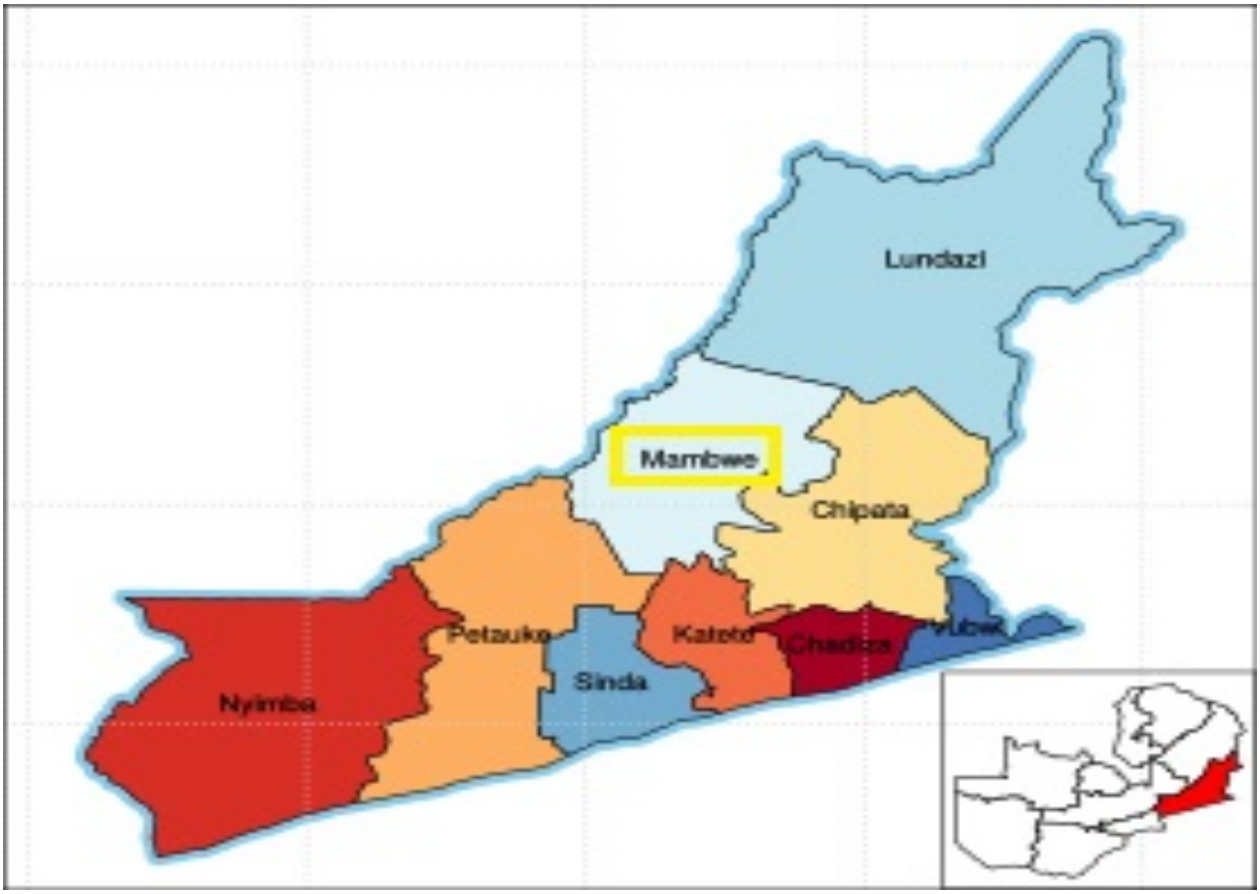


Figure 1: Map of the Eastern Province showing location of Mambwe District

Chikowa Sam is one of ten dams that have been selected for remedial works under the World Bank-funded IDSP. The current structural integrity of Chikowa Dam has been heavily compromised with observed legacy issues, and therefore has become a threat to the safety of the local community. UNOPS has been tasked to prepare this Environmental and Social Management Plan (ESMP) on behalf of the Government of the Republic of Zambia. The ESMP guides the remedial works on the dam, mitigates imminent identified risks to the environment and the safety of communities and their associated livelihoods, and brings the dam into compliance with World Bank safeguards policies.

UNOPS has conducted desk reviews, interviewed and consulted key sub-project stakeholders, and gathered field data at the dam site. Initial field screening visits by the team revealed the need for an in-depth biodiversity assessment of the dam site. The biodiversity assessment was conducted separately and

a BMP has been prepared, annexed to this document. The BMP was prepared based on the findings from a biodiversity assessment.

The Dam remedial and rehabilitation works to address structural and non-structural non-compliances will commence after ESMP approval and disclosure. The ESMP will then be communicated to the stakeholders prior to the remedial and rehabilitation works. It is projected that the proposed works at Chikowa Dam will take about 6 months.

1.1 Project Background and Description

Chikowa Dam is a new zoned earthfill dam with a gross storage capacity of 773,000 m^3 and with a maximum height of 11 meters, predicted to inundate 19.1 hectares at full supply level according to the initial design report. Construction of the embankment and spillway was completed in 2018, although the requirements for a few technical improvements were noted. No irrigation system existed at the time, and the envisaged activities under the WRDP included irrigation of 45 hectares of cropland, and aquaculture using fishponds[1].

The Water Resources Development Project (WRDP)

The WRDP became effective in 2013 and was closed in 2018. The Project Development Objective (PDO) of the project was 'to support the implementation of an integrated framework for development and management of water resources in Zambia'. The WRDP had three components: Component A: Water Resource Management; Component B: Water Resources Development; and Component C: Institutional Support. Component B included support to the design, rehabilitation and construction of 100 small dams. Of these, only 12 dam sites were procured for construction or rehabilitation. Two of the twelves dams had issues with the foundation conditions and therefore were dropped from the list. The 10 dams remaining include Chikowa Dam.

***WRDP E&S Safeguard*s:** The project was classified as a 'Category B' project under the World Bank safeguards policies, and several World Bank safeguards policies were triggered. As a result, the following instruments were prepared, consulted and agreed upon: i) Environmental and Social Management Framework with provisions for cultural resources management and protection; ii) Pest Management Plan; and iii) Resettlement Policy Framework. The World Bank Integrated Safeguard Data Sheet (ISDS) indicated that the project would not finance the construction of large dams and required only the generic dam safety measures contained in existing operational procedures and the application of the 2010 Food and Agricultural Organization (FAO) Technical Guide for Small Earth Dams for compliance with safeguards on dam safety.

The World Bank's mid-term review of the WRDP, however, identified non-compliance issues with safeguards policies and poor quality of construction of the Chikowa and other dams. As a result, the Project Management Unit prepared Environmental Project Briefs (EPBs) for the dams, which were finalized between March and June 2016 and approved by Zambian Environmental Management Agency (ZEMA) between January and May 2017. However, these EPBs were not compliant with World Bank safeguards policies and despite efforts to rectify the issue, the non-compliance persisted. As a consequence, on March 26, 2018, the World Bank issued a Partial Suspension of the project. The suspension limited project expenditure to addressing safeguards issues and remediating the dams that

[1] COWI Report; Abbreviated Resettlement Action Plan for Chikowa Dam Project, 2018

had already been built or rehabilitated under the WRDP. Although EPBs and an ESMP for 8 dams were in place, remedial works at the ten dam sites had not taken place at the time of closure in 2018. Since project closure, the World Bank and GRZ have worked to address the outstanding issues, given the responsibilities and obligations of the parties set out in the WRDP's Financing Agreement. On October 10, 2019, the World Bank and the GRZ agreed on remedial actions to ensure the safety of the 10 dams that were constructed/rehabilitated under the WRDP. To address the shortfalls, remedial works would be financed under the Irrigation IDSP.

Irrigation Development Support Project (IDSP)

The IDSP (P102459) was approved and became effective in 2011. Two restructurings of the original project changed the Project Development Objective (PDO, the number of components and the closing date. The current PDO of the IDSP is to 'provide improved access to irrigation services in selected sites in the Recipient's territory'. The project consists of three components:

- Component 1: Public infrastructure investment;
- Component 2: Development of irrigation management capacity; and
- Component 3: Project management and coordination

As part of the 2019 agreement, it was decided that the remedial work of these dams will be carried out through the IDSP, based on a two phased approach. The first phase is financed by the IDSP parent project, the second phase by the AF.

Phase 1 covers preparatory activities that will facilitate the works to remediate dam safety and integrity and to realise its original intent (which was to the benefit the local community and the department of agriculture). The scope of Phase 1 consists of a) undertaking the necessary investigations for remediation, including in regards to dam safety and environmental and social safeguards; b) preparing an ESMP and Biodiversity Management Plan; c) undertake immediate, limited, structural and non-structural interventions to minimize immediate risks to communities caused by the dam.

IDSP Additional Financing (AF)

The AF extends the deadline of the IDSP to 30 November 2022. It consists of three distinct sets of activities: Activity 1: Completion of ongoing works under the IDSP and cost replenishment; Activity 2: Remedial works for the 10 WRDP dams; Activity 3: Drought emergency response. The remediation of Chikowa Dam and the 9 other dams will be implemented under activity 2.

Phase 2 of the 2019 agreement and activity 2 of the AF provides remedial activities to reduce the risks/impacts related to construction and operation of the Chikowa Dam and provide support through training and capacity building, which is required to safely operate the dam and reduce the downstream environmental impacts. It is envisaged that the activities associated with the works will not change the nature and scope of the existing scheme and will not increase the dam's existing capacity. With this, it is projected that the remedial measures will not adversely change the quality or quantity of water flows downstream to other areas.

The scope of Phase 2 for Chikowa Dam consists of:

a) Civil works on the dam to ensure the safety of dam and downstream communities;
b) Establishment of operation and maintenance arrangements;
c) Continuation of surveillance;
d) Upon completion of the works, hand-over of the management, operation and maintenance

of the dam to a DMC comprising of member of the beneficiary communities;

e) Implementation of the Environmental and Social Management Plan (ESMP), including remediation of environmental legacy areas such as borrow pits and spoil areas, etc.; and
f) Training of communities on how to operate the dam and conserve the catchment.

1.2 Objectives of the ESMP

This ESMP has been prepared to guide all the works on Chikowa Dam during Phase 2 of the IDSP AF. The main objectives of this ESMP are to mitigate imminent identified risks to the environment, safety of communities, and their associated livelihoods, and to bring the dam construction and operational management into compliance with World Bank safeguards policies.

1.3 Methodology

This ESMP is based on a desk review of available information and field data collection, which included consultations with members of the Chikowa dam community, local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Chikowa dam site for detailed on-site assessments of the environmental and social impacts of the sub-project. This ESMP has been guided by the Zambian Environmental Management Act EIA Regulations (1997), as well as by the World Bank's Operational Policies (OPs). Reference is made to the initially prepared and approved EPBs (WRDP 2017), the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (ESA) (IDSP April 2020), and recent dam assessments in order to determine environmental and social requirements for rehabilitation and restoration measures. The EMSP follows the format, which is laid out in the Environmental and Social Audit.

In summary the following activities were undertaken by UNOPS:

- Literature review, including data and documentation provided by the IDSP to UNOPS:
    - Remedial Environmental and Social Management Plan of Eight (8) Dams Under the Water Resource Development Programme (2018)
    - Approval Decision letters by Zambia Environmental Management Authority (2017)
    - Environmental Project Briefs (EPB) prepared under WRDP (2017)
    - Environmental and Social Audit (ESA) of 10 Dams (IDSP 2020)
- Field studies by the UNOPS environmental and social (E&S) safeguards and engineering teams in July 2020, accompanied by IDSP team members.
- Site environmental and social assessments.
    - Site and analytical geotechnical studies
    - Site surveying
    - Site and desk terrestrial and aquatic biodiversity studies
    - Site and desk hydrological studies
- Public participatory interviews, focus group discussions and community consultations.
- Environmental quality monitoring – water quality sampling and analysis.
- Ad hoc, matrix and checklist methods of impact assessment.

The ESMP has included the preparation of the following plans and reports:

- Policy, legal and institutional framework

- Baseline conditions
- Remedial design with
    - Geotechnical information
    - Survey information
    - Hydrology information
- Safety reports-operations and maintenance/ emergency preparedness plan
- Biodiversity management plan
- General construction works management plan
- Rehabilitation plan
- Training plan and stakeholder engagement
- Grievance redress mechanism
- ESMP implementation process

2. Policy, Legal and Institutional Framework

Environmental and social sustainability is vested in international and national policies, laws, regulations, guidelines and standards that guide the implementation of this sub-project. The below table outlines key legislation that regulates the environmental and social aspects during dam rehabilitation through to the operational phases. The sub-project activities must fully comply with the relevant legislation of the Republic of Zambia as well as with the World Bank safeguards policies.

2.1 National Policy and Legislative Framework

These policies and others are actively implemented through compliance with the legislative frameworks described below. Table 1 outlines the various laws of the Republic of Zambia that are relevant to the proposed works.

Table 1: Laws relevant to the sub-project

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Environmental and Natural Resource Management			
Environmental Management Act No.12, 2011	To protect the environment and control pollution, so as to provide for the health and welfare of persons, animals, plants and the environment. This Act provides for the management of effluent discharge, air and noise pollution, the parameters which are relevant to this sub-project.	UNOPS to ensure the relevant regulations are mainstreamed in the ESMP and enforced IDSP to monitor compliance throughout sub-project lifespan	Activities to be undertaken as remedial measures to the dam's safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are put in place in order to eliminate or reduce the effects of these impacts. The measures are consistent with the requirements in the Environmental Management Act of 2011. As an example, some of the works to be undertaken may result in environmental discharges that will require ZEMA licenses for compliance and monitoring. Relevant pieces of regulations have been mainstreamed in this ESMP to ensure the contractor's compliance with the regulations during the rehabilitation of the dam.
Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997	Under these regulations, a developer will not implement a project for which a project brief or an environmental impact statement is required, unless the project brief or an environmental impact assessment has been concluded in accordance with these Regulations and		At the national level, the Environmental Impact Assessment (EIA) regulation of 1997 gives guidance, schedules and categories for the various project types and the relevant EIA studies to be undertaken. It further gives provision on post- EIA approval management of projects and guidelines for developing ESMPs. This has been followed.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	the Council has issued a decision letter.		
Solid Waste Management Act of 2018	To ensure disposal of generated solid waste to designated sites	UNOPS to ensure the regulation is enforced through the ESMP. IDSP to monitor compliance throughout the sub-project lifespan; local municipal authority.	The ESMP has taken into consideration solid waste management at work sites by introducing a parameter that will compel the contractor to take care of all the generated solid waste at its worksites and appropriately dispose of the same.
Natural Resources Conservation Act, Cap 315, 1970	To conserve and protect both natural and cultural heritage, e.g. waterfalls, in perpetuity and other resources within the boundaries of the site for the benefit of the present and future generations.	UNOPS to ensure enforcement during preparation and construction phase IDSP to monitor compliance throughout sub-project lifespan	The ESMP takes into consideration the BMP, which details specific conservation and mitigation measures to ensure sub-project activities promote the conservation and protection of both natural and cultural heritage in the sub-project affected areas, in compliance with the regulation.
Fisheries Resources Management			
Fisheries Act, Cap 200, 1974	Provides for development of commercial fishing and the registration of fishermen and their boats and the protection of endangered fish species.	IDSP Monitoring: Ministry of Agriculture and Livestock	The proposed dam will be used for fishing; commercial fishing may be eventually developed by communities, once trained in the same. The provisions of this Act will be complied with in the management of these fish resources. Fishing will be conducted according to the regulations and the Fisheries Department will be involved to educate the community activity. UNOPS, on behalf of the GRZ, has included actions to ensure species are protected with the involvement of the relevant Department of Fisheries in the District.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Lands Management			
The Lands Act, 1995 (CAP 292, CAP 289, CAP 288)	The Department of Lands administers the Land Act, 1995 (CAP 292, CAP 289, CAP 288) and the Lands Acquisition Act, 1995 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible for the administration of lands and deeds registration and land surveys and mapping.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Lands, Natural Resources and Environment Protection	No additional land is expected to be required for this sub-project. If any land acquisition be required, UNOPS/ IDSP will comply with this regulation which governs the acquisition of the land to be used for various developmental activities.
Urban and Regional Planning Act, No. 3 of 2015	Provides for the appointment of planning authorities, the preparation approval and revocation of development plans, and the control of development and subdivision of land.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Local Government and Housing; local authorities	The land around the dam falls within traditional tenure. UNOPS, on behalf of the GRZ, will comply with this regulation for the approvals of construction and development plans within a locality if required.
Local Government Act, 1990	Provides for the establishment of councils in districts, the functions of local authorities and the local government system.	Ministry of Local Government and Housing Local Authorities	The function of the municipalities is guided by the provision of the Local Government Act. UNOPS, on behalf of the GRZ, will comply with the requirements of this Act for measures related to pollution control and environmental protection functions which are handled by the local council. It will ensure that the council and stakeholders are involved in the planning, rehabilitation and operation activities.
Agricultural Lands Act No	The Act establishes the Agricultural Land Board and provides for its functions	UNOPS to ensure enforcement during	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
13 of 1994 (Cap. 187)	which inter alia includes; keeping under review the use that is being made of state land, outside urban and peri-urban areas and to make recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.	preparation and construction phase Monitoring: Ministry of Agriculture	assessment of the impacts of these activities on the agricultural areas in the sub-project area was undertaken. UNOPS, the contractor and stakeholders will comply with this law in relation to rehabilitation and operation of the dam.
Traffic Management			
The Road Traffic Act No. 11 of 2002	Establishment of the Road Transport and Safety Agency (RTSA). It also provides for a system of road safety and traffic management in Zambia.	Contractor Monitoring: UNOPS	The transportation of construction materials has the potential to cause accidents, hence traffic control measures must be employed and their development must comply with provisions of the Act. UNOPS and contractors will comply with all the regulations under this Act, traffic safety rules for communities, traffic management. This ESMP includes a traffic management plan.
Tourism Management			
Zambia Wildlife Act No. 14 of 2015	Management and Protection of National Parks and Wildlife respectively	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Tourism	The dam is located in a remote rural area; hence UNOPS, on behalf of the GRZ, will comply with the requirements of this regulation, if protection of wildlife is required. The ESMP determines appropriate action to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including ecologists on the team. A BMP was prepared and annexed to this document for reference.
Forestry Resources Management			
The Forest Act No. 4 of 2015	Control, manage, conserve and administer national and	UNOPS IDSP	The project area is close to a forest reserve, protection of the reserve will be provided with guidance of the Department of

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	local forests; Participation of local communities, traditional institutions, and NGOs; conservation and sustainable use of forests and trees.	Monitoring: Zambia Forestry Commission (yet to be established) / currently by the Department of Forestry	Forestry. In situations where forest resources are affected by the project, approvals and permits from Forestry Department will be obtained prior to disturbing the forest. Permits and approvals are the responsibility of the contractor.
Employment and Labor			
Workers' Compensation Act No. 10 of 1999 Employment Act	All employment regulations and laws.	Contractor, UNOPS Monitoring: Ministry of Labour	UNOPS will, on behalf of the GRZ, ensure that the contractor comply with provisions of these regulations during the course of employment.
Occupational Health and Safety Act	Provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery.	Contractor, UNOPS Monitoring: Ministry of Labour	UNOPS, on behalf of the GRZ, will ensure that the contractor complies with the occupational health and safety requirements of the Act, promotes safety by putting in place all measures required to ensure the well-being of the workers.
Worker's Compensation Act No. 10 of 1999	Establishment and administration of a Fund for the compensation of workers disabled by accidents to, or diseases contracted by such workers in the course of their employment, and for the payment of compensation to dependants of workers who	Contractor, UNOPS Monitoring: Ministry of Labour	This Act is relevant to the sub-project because workers are at higher risk of suffering from injuries that could lead to disabilities or contracting diseases due to the nature of their work environment. In the event of work-related accidents, the provisions of this Act will be triggered. UNOPS and its contractors will comply with regulations under this Act by registering with the workers compensation Board and being compliant by providing safe working sites.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	die as a result of such accidents or diseases.		
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with public health. This law may be read together with the Local Government Act, Cap 281 of the laws of Zambia. The Act empowers the Ministry of Health and the Councils to prevent diseases and pollution dangerous to human health, as well as prevention of pollution to any water supply for domestic use.	Contractor, UNOPS Monitoring: Ministry of Health	The sub-project is likely to cause pathogens due to human activities. Measures to prevent diseases and pollution particularly during the rehabilitation and operation phases will be instituted. UNOPS, on behalf of the GRZ, will take measures to prevent diseases and pollution dangerous to human health by ensuring that there are good sanitation and waste disposal systems on the working premise (prevention of vectors, etc…). COVID-19 prevention and management measures are included in this ESMP.
The Gender Equity and Equality Act, 2015	Taking of measures and strategic decisions to ensure gender equity, equality and integration of both sexes in society; promotes gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibits harassment, victimization and harmful social, cultural and religious practices;	Contractor, UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social Services	Sub-project works and operation will require gender mainstreaming and prevention and mitigation measures for GBV. UNOPS and its contractors will comply with all the regulations under this Act. This ESMP includes a Gender Equality and GBV Action Plan.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	provides for public awareness and training on issues of gender equity and equality; provides for the elimination of all forms of discrimination against women, empowers women and achieve gender equity and equality		
The Anti-gender-based Violence Act, 2011	The Act provides for the protection of victims of gender-based violence; constitutes the Anti-Gender-Based Violence Committee.	Contractor, UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social services	Worker influx bears risks of GBV cases. UNOPS and its contractors will comply with all the regulations under this Act. Sensitisation, reporting and referral pathways will be put in place.
Disaster Management			
Disaster Management Act, 2010	Establishes and provides for the maintenance and operation of a system for the anticipation, preparedness, prevention, coordination, mitigation and management of disaster situations and establishes the Disaster Management and Mitigation Unit (DMMU).	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Office of the Vice President District Commissioner Office	Dam safety risk and emergency response measures need to be in concordance with the Act and should involve the necessary stakeholders. UNOPS engineering and safeguards teams will work together for remedial actions that promote safety. The UNOPS and IDSP will involve the DMMU in implementing safety and emergency measures.
Zambia Coronavirus Disease	Construction and operational activities will involve workers and the	UNOPS to ensure enforcement during	COVID-19 prevention and management measures are included in this ESMP.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
(COVID-19) Statutory Instruments *	community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	preparation and construction phase	

- Public Health (Infected Areas) (Coronavirus Disease 2019) Regulations, No. 22 of 2020; Public Health (Notifiable Infectious Disease) (Declaration) Notice, No. 21 of 2020; The Employment Code (Exemption) Regulations, 2020; The Public Health (Infected Areas) (Coronavirus Disease 2019) (Amendment) Regulations, 2020

2.2 World Bank Operational Policies

This sub-project will fully comply with the World Bank OPs. In addition, it will be guided by the WBG Environmental, Health and Safety Guidelines (EHS Guidelines); The World Bank's Good Practice Note on 'Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works'[2]; as well as World Bank guidance on 'Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx[3].

Table 2 describes the triggered policies and actions to be followed by the IDSP AF/UNOPS and the constructor. The ESA indicated 6 triggered policies for the project, but the Chikowa Dam subproject has not triggered the OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the subproject as this was already covered in 2018 under COWI[4]; it has not triggered OP 4.09 (Pest Management) because it is a livestock dam and has not triggered OP 7.5 (Project on International Water Ways). The reason is that the Chikowa Dam was created by blocking the non-perennial Kasenengwa River, which flows into the Lupande Stream. Lupande finally flows into the Lwangwa River. The Luangwa River is not internationally shared with another neighbouring country, but is one of the major tributaries to the Zambezi River. Kasenengwa River, which feeds into Luangwa River, is many kilometers away. The pollution or contamination that may be introduced in the Kasenengwa River will not reach Zambezi River due to the distance between the Kasenengwa River and the Zambezi River.

Table 2: Relevant World Bank Operational Policies

OP	**Name**	**Actions to be followed by the IDSP AF / UNOPS**
OP 4.01	Environmental Assessment:	The project was classified EA Category B and an Environmental and Social Audit (ESA) was prepared to comply with OP 4.01. The policy is triggered because of the potential impacts the remediation works on Chikowa Dam could have on the environment and people. Some of the potential impacts include: soil excavations, borrow pits, construction waste, clearing of vegetation, noise, sedimentation, downstream flow restrictions, etc. For the remediation works at Chikowa Dam, UNOPS has prepared this ESMP, following the requirements defined in the ESA. The sub-project will implement all measures described in both instruments to mitigate all identified negative impacts.

[2] World Bank, Good Practice Note. Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, September 2018
[3] World Bank, Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx, OPCS and ESSAT, December 2016.
[4] Abbreviated Resettlement Action Plan for Chikowa Project Site, WRDP, 2018

OP 4.04	Natural Habitats:	This policy is triggered because the construction of the dam has caused impacts in natural and modified habitats. Also, the impact of the operation of the dam on the downstream flow and the induced impacts of increasing human populations on both aquatic and terrestrial ecosystems were identified in the ESA as an area of weakness in the previous safeguard instruments. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment, including creating a barrier to the movement of aquatic species. The opportunity to properly address these issues, as required by OP 4.01, has to some extent passed. The dam is already built. There are, however, some options for impact minimization, as well as actions to make the most of the potential benefits of flow regulation. Chikowa Dam was constructed on a seasonal stream and therefore may not have significant flows in dry season. This ESMP provides measures to mitigate negative impacts on terrestrial and aquatic ecosystems in the area of influence of the dam, which include impacts that will be caused by the current construction teams in their day to day activities and those caused by the previous construction works (see remediation plan in this ESMP). In addition, UNOPS Ecological Experts conducted a biodiversity assessment and developed a BMP to promote conservation of flora and fauna during and after the remedial works.
OP 4.06	Forests	This policy is triggered because potentially during future operation of the dam and expansion of the agricultural areas, tree loss and impacts on riparian forest could occur. In future, the Ministry of Agriculture will have to obtain relevant permits for expansion of agricultural activities around the dam, whenever need arises during the operational stage. Increasing populations supported by the irrigation schemes will create additional pressure on surrounding habitats, which may be important in the cases where the dam is in habitats with little transformation. A Biodiversity Management Plan (BMP) has been prepared. The document discusses baseline investigations of terrestrial habitats, flora and fauna for purposes of ensuring the potential biodiversity impacts are taken care of during the remedial works. Other parameters discussed in the BMP include the environmental restoration and the subsequent monitoring plans based on the results of the field assessments.
OP 4.37	Safety of the dam	This policy is triggered because of the identified legacy structural non-compliances which compromise on the integrity of the Chikowa Dam.

	UNOPS and its contractors will follow Good International Industry Practice (GIIP) to determine and implement corrective actions that mitigate dam safety issues. For the sub-project a *Plan for construction supervision and quality assurance*, *Operation and Maintenance (O&M) Plan*, and an *Emergency Preparedness Plan (EPP)* have been prepared.

2.3 World Bank Group Environment Health and Safety Guidelines

The WBG EHS Guidelines contain the following guidelines included in the ESMP to be applied on the subproject:

- Environment- air emissions and quality; energy conservation; wastewater and ambient water quality; water conservation; hazardous materials management; waste management; noise and contaminated land.
- Occupational health and safety- facility design and operation; communication and training; hazards; PPE and monitoring.
- Community health and safety- water quality and availability; infrastructure structural safety; life and fire safety; traffic safety; transport of hazardous materials; disease prevention and emergency preparedness and safety.
- Construction with decommissioning –environment, occupational health and safety and community health and safe**.**

3. Institutional Arrangements for E&S Management of the Sub-Project

The Chikowa Dam remedial works will be managed and implemented by the Ministry of Agriculture of Zambia. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works of the ten dams, including Chikowa Dam. The IDSP-PIU Environmental & Social (E&S) Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities implemented by the UNOPS Sub-PIU and UNOPS contractor at the Chikowa dam site. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the E&S mitigation measures laid out in this ESMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The institutional arrangements are summarized in Figure 1.

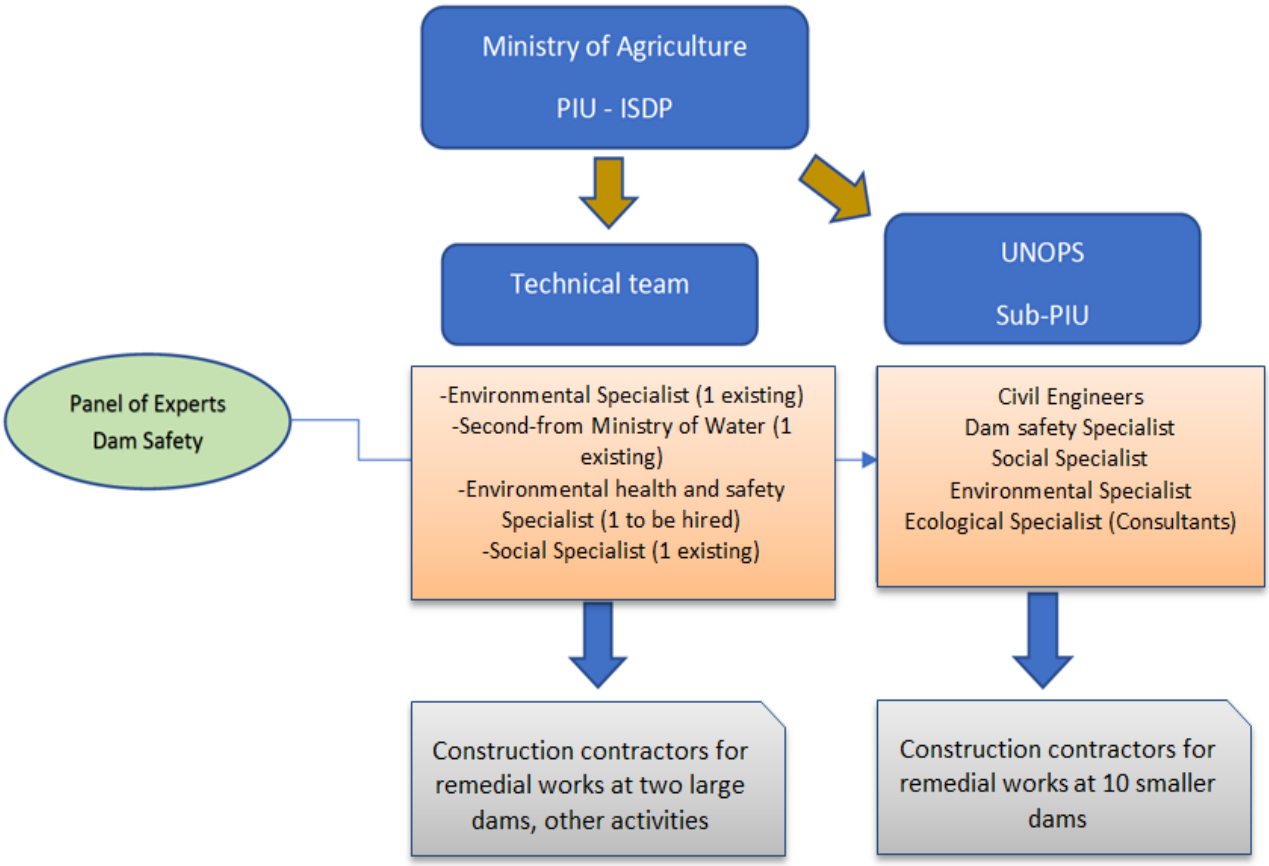


Figure 2: Institutional arrangement for sub-project implementation

3.1 Ministries / IDSP-PIU

The IDSP-PIU is situated within the Ministry of Agriculture and will have overall oversight of the dam remediation works and the implementation of this EMSP.

The IDSP-PIU will therefore include one environmental specialist, one environmental health and safety specialist, and one social specialist to support the overall supervision of the remedial works.

The IDSP-PIU will further provide support to the dam remediation activities through a dam safety panel of experts, which will have oversight over the works, remediation plans, safety plans, etc…

The IDSP-PIU will retain the primary responsibility of ensuring that environmental and social commitments for Chikowa Dam are met throughout the sub-project lifespan vis-à-vis the World Bank.

The IDSP-PIU will establish a schedule of supervision and monitoring for the environmental and social management of the Chikowa dam site. Environmental and social issues are the responsibility of all personnel, from the management to the operator. However, day-to-day supervision and monitoring for the planning and implementation of the whole sub-project lies specifically with the environmental specialist, the environmental health and safety specialist and the social specialist (Figure 1). Furthermore, at least one additional Ministry of Agriculture (MoA) field staff member working with the environmental health and safety specialist should take up the responsibilities of ensuring continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP.

The three specialists will supervise all E&S related matters for the works under the AF. This includes supervision of UNOPS and the UNOPS contractor at the Chikowa dam site. This E&S supervision includes the operationalization of the dam, during which period the IDSP staff will be working with the respective local authorities, DMC and local communities, in preparation for a smooth handover when IDSP ceases to exist as a project.

The IDSP-PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam.

3.2 United Nations Office for Project Services (UNOPS)

The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Chikowa Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this ESMP. UNOPS has been tasked with the design of the remedial works and the preparation of this ESMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works and the implementation of E&S mitigation measures. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period.

The UNOPS technical team will include civil engineers and a dam safety specialist. Environmental and social issues will be the responsibility of one environmental specialist, one social specialist and one ecologist. This technical team will be located at the UNOPS Sub-PIU in Lusaka, with frequent travel to the Chikowa dam site.

The environmental specialist, the social specialist and the ecologist will be involved in the environmental and social management of Chikowa Dam. In addition, the team will supervise and monitor the implementation of environmental and social mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU.

3.3 The Contractor and Sub-Contractors

The contractor will be responsible for carrying out the work at the site in compliance with this ESMP, in accordance with applicable Zambian laws and regulations governing environmental and social impact management, pollution control, waste management, occupational health and safety, and the World Bank OPs.

The contractor will appoint one full time HSSE Officer to serve at the construction site throughout the entire period and ensure implementation of the ESMP. Among other obligations, the Contractor will comply with all labor and gender equality requirements on site, as specified in this ESMP, and will brief the Chikowa DMC and relevant government officials through regular meetings.

The contractor is required to prepare method statements for the implementation of sub-project aspects, and to operationalize all action and management plans as defined in this ESMP (including non-hazardous waste, hazardous materials and waste, surface and groundwater pollution, protection measures for terrestrial and aquatic fauna and flora, air quality and noise, labor and working conditions, sanitation, gender equality, GBV, provision of flow during construction, environmental remediation and rehabilitation, maintenance and monitoring). This will be outlined in the procurement documentation provided to the contractor. The contractor's method statements will be submitted to UNOPS for approval prior to commencement of work.

3.4 The Dam Community

As the owner of the dam, the dam community will be encouraged to be an active partner during the construction and operational period. The committee will be regularly consulted on a variety of issues (see stakeholder engagement section) and will be encouraged to report any grievance or misconduct by the contractor or contractor personnel to the IDSP-PIU through the GRM which has been designed for the AF activities. The DMC and community representatives, such as the headmen, will verify to ensure that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the stakeholder engagement plan below, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the environmental and social mitigation measures undertaken. Stakeholder engagement ensures that dam communities are consulted throughout the construction and operational phases.

The dam is operated by a DMC, which consists of community members living in the vicinity of the dam. Currently the committee is semi-active, and consists of 5 women and 5 men, as shown in Appendix G. The Chikowa DMC is a decentralized organization where user communities have been ceded rights and have responsibilities for managing their own resources, typically using a mix of traditional or more formalized mechanisms of contract and enforcement to define, access, exploit, maintain and share dam resources or benefits. Due to the complexity of managing dams, the management structure is widened to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been/will be involved during planning, construction and operation phases. Its role will include involvement in stakeholder engagement, auxiliary sites selection, employment, ESMP implementation, operation guidelines and monitoring, operation maintenance and dam safety. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP will continue to inform communities of their expected obligations and contributions during consultations and training.

The DMC has not been trained appropriately to commence the dam monitoring activities. The committee is yet to set rules, through a constitution, which will be communicated to the users, once given a go ahead after rehabilitation of the dam. Some aspects to be covered include fauna and flora conservation rules in the Chikowa dam environment.

During the remedial works, the DMC will be trained to manage the dam during the lifespan of its operation stage. Once the remedial works are completed, the contractor will handover the dam to the DMC who will ensure sustained maintenance of the dam during the operation period. Capacity building of the DMC members become very important for them to effectively manage to maintain the dam and its environment. It is planned that their training must include dam safety management/structural deterioration; gender equality; health and safety aspects, erosion control and conservation.

MoA has representatives at the dam site who will continuously monitor the remedial works and report to IDSP.

4. Environment and Socio-economic Baseline Conditions

4.1 Physical Conditions

4.1.1 Geology

Regional Geological Information

The geology of the Mambwe area is formed by the Mozambique Belt, which occurs in pegmatite hosted within granitic gneisses and schist of the basement. Pegmatites occur extensively within the basement of eastern and central Zambia. The rocks include granitic gneisses and schists. The main soil types at the proposed site are sandy loam soils. The soils within the woodland are shallow, leached and slightly acidic, underlain with laterite (Storrs, 1979). The average soil depth is less than 50cm. The underlying rock on the Mozambique Belt is rich in feldspars, limestone etc... As such, the Eastern Province is a vital granite mining region.

The aquifers on the Eastern Province may be characterized as low yielding aquifers with limited potential and aquifers where flow is mainly in fissures, channels or discontinuities, which in turn may be divided into locally productive aquifers and highly productive aquifers. The low yielding aquifers dominate the area.

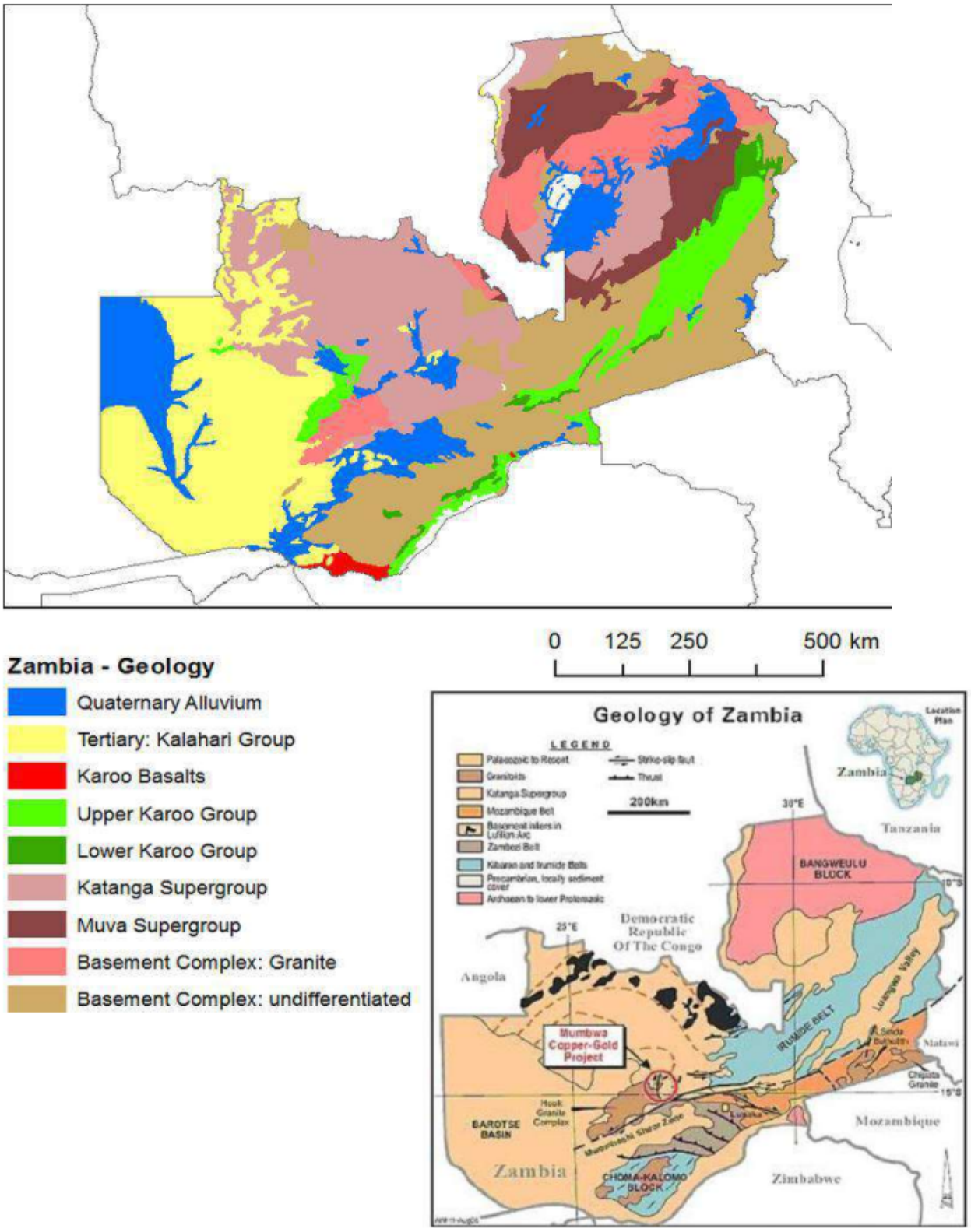


Figure 3: Map showing the geology of Eastern Province and Mambwe District

4.1.2 Topography

The study area is generally hilly and gently undulating with some low lying areas. The topography of Mambwe District is characterized by some mountains and valleys oriented generally in the north to south direction.

Around the dam and in the areas close to the dam, the general topography ranges from 632m above the sea level for low lying areas to 645m above the sea level in higher areas. The highest point of the district are the southeastern areas, which measure around 720mm above sea level. The northwestern area of the district drops to around 600m, which is the direction of the overflow from the dam to join the Luangwa River.

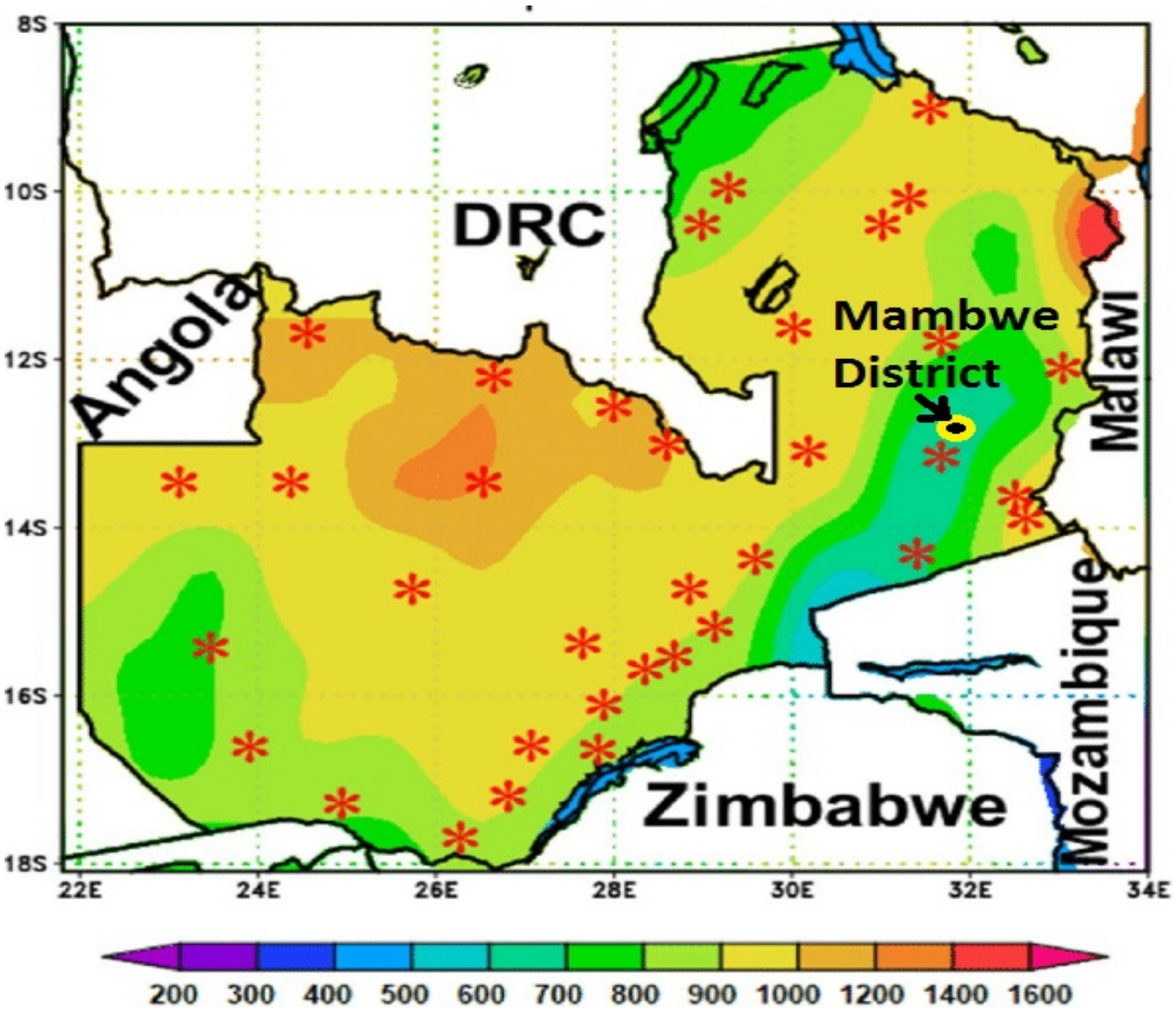


Figure 4: Map showing topography of the project area

4.1.3 Groundwater

Generally, the area has limited groundwater potential with yields as low as 0.2 liters per second, up to 2.3 liters per second in a few areas. Water quality for both, surface and groundwater (shallow wells), used by the local community, does not meet drinking water standards, due to high total suspended solids in the surface water, and in some cases organic and inorganic pollution, probably caused by fertilizers, pesticides and pit latrines. The water is generally suitable for irrigation. The Chikowa Dam is one potential source of water for the Mambwe District, once the spillway is rehabilitated.

4.1.4 Surface Hydrology

The Kasenengwa River is a seasonal stream, which dries up around April/May every year. The dam is located on the Kasenengwa Stream, which flows into the Lupande River, which in turn is a tributary of the Lwangwa River. The dam is at an altitude 631 masl and will inundate an area of approximately 19 ha. The reservoir catchment area is 54,8 km^2.

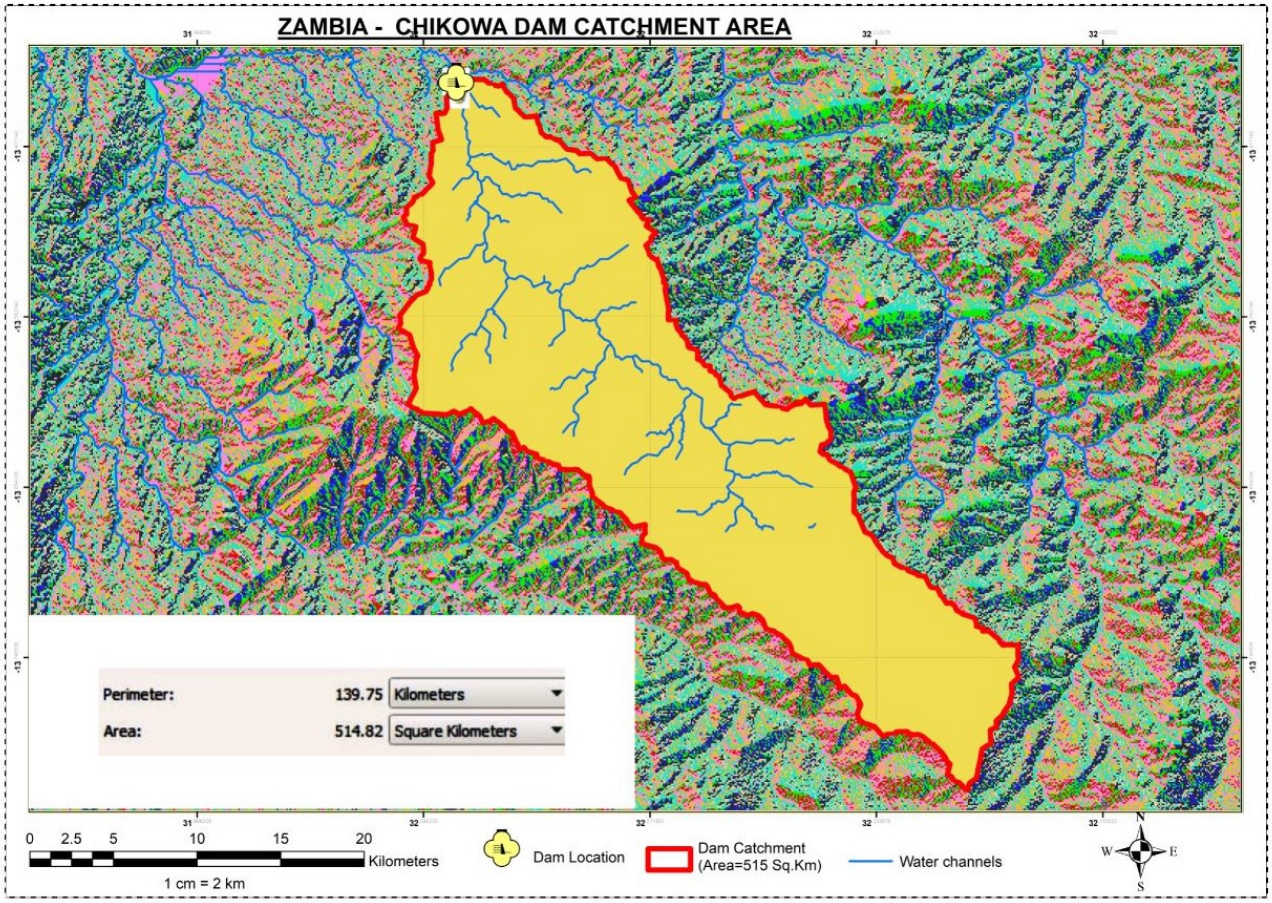


Figure 5: Map showing Chikowa dam catchment area

The projections on the extent of the flood on the Chikowa Dam and downstream are shown in the figure below.

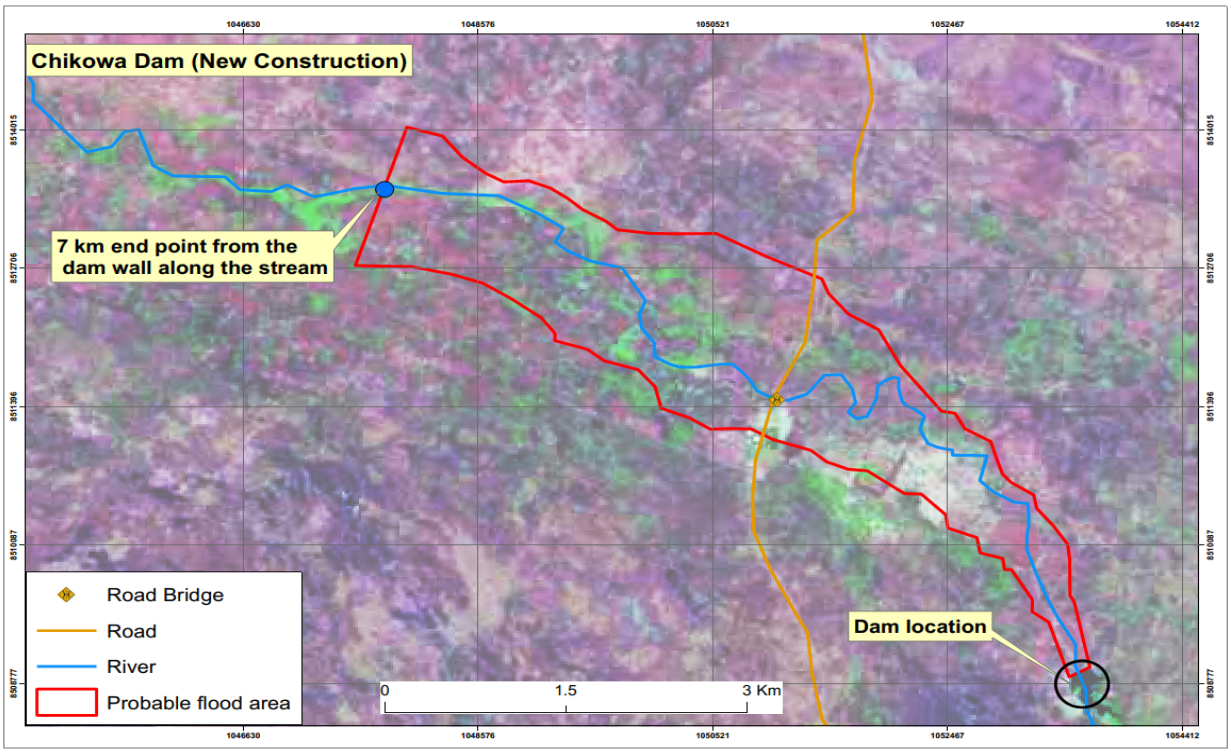


Figure 6: Chikowa Dam Flood Map

4.1.5 Surface Water Quality

The population is concentrated in small to medium sized villages situated along the Kasenengwa River downstream of the dam site. Those away from the river draw water from their wells. In most cases unprotected water from these wells is used for domestic purposes. Communities close to the river do access water from the river for domestic purposes. However, some community members near the Kasenengwa River have dug shallow wells along the banks of the river for water for their domestic purposes. The only setback is that these wells dry up during the dry season.

The dispersed nucleated settlements are inhabited by extended families and form villages, mostly on the northern and north-western side of the dam - with a clearance of about 50m. There are few settlements on the eastern side of the dam - with a clearance of at least 100m. Otherwise, a number of such villages are located away from the dam. There are a few boreholes in operation and accessed by the local community for their domestic use. The dam may suffer from siltation aspects due to agriculture activities conducted by the community upstream of the dam and the frequent access to drinking water by their livestock. Currently, the status of the eroded banks of the river downstream of the dam have the potential to contribute to sedimentation in the river system. Additionally, open defecation by the community near the river and the waste deposits upstream have the potential to contaminate the river system downstream via the rainwater. Livestock that accesses water from the upstream of the dam may contaminate the water with their waste, introducing more of phosphates and ammonia in the river system.

Plate 1: Chikowa Dam – Downstream showing exposed areas as a result of poor spillway conditions

Plate 2: Picture showing no settlements near the dam

Plate 3: Livestock on the way to access drinking water but on the downstream of the Chikowa dam

Plate 4: Animals about to access water, the area is open to soil erosion

The dam site on the Kasenengwa River was selected as the best option to serve as water source for livestock, aquaculture and irrigation purposes. Upstream of the Kasenengwa River are very few subsistence farmers, who must be educated on how best to conduct their farming in order not to cause siltation and avoid contaminating the surface water body with siltation, nitrates and phosphates through soil erosion and reckless application of fertilizers in their fields.

To confirm quality of water accessed by the local community in the sub-project area, water samples were collected in the dam reservoir and analyzed at the University of Zambia.

Plate 5: Picture showing water in the reservoir and the sampling point

Table 3 shows the results of the water quality sample taken in Chikowa Dam in 2020, compared with other dams of this project. The test results indicate that the relevant parameters are all within the statutory limits for WHO drinking water parameters.

Additionally, the water analysis results obtained in 2016 also show that the water quality in the Chikowa reservoir is good enough for domestic chores.

Table 3: Water analytical results for Chikowa Dam compared with the other dams

SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS
Lusaka
Sampled by : Client
Report date : 15.01.2021

Laboratory Results

	Ndondi Dam Reservoir Pemba 17.07.2020	Kawiko Dam Mwinilunga Dam Reservior 15.07.2020	Kanyika Dam Kasempa Dam Reservior 17.07.2020	Nabowa Kaoma Dam Reservior 19.07.2020	Chikowa Dam Drinking Point 09.07.2020	Katembula Lufwanyama Dam Reservior 13.07.2020	Chibalashi Dam Mansa Dam Reservior 09.07.2020	Ngolongozya Dam Dam Basin Zimba 14.07.2020	Makaba Dam Namwala Dam Reservior 15.07.2020	Nachibanga Dam Pemba Dam Reservior 17.07.2020
pH	6.97	5.37	6.26	5.80	6.76	6.82	6.46	6.29	6.90	6.72
Conductivity (µs/cm)	85	15	186	80	352	194	36	76	72	92
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	2.50	1.70	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	0.20	<0.01	<0.01	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	0.30
Total Dissolved Solids (mg/l)	42	8	93	40	176	97	18	38	36	46
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	0.10
Phosphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	3.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.6	5.2	12.8
Chemical oxygen demand (as mg O_2/l)	5	8	10	12	4	7	5	5	7	8
Chlorides (mg/l)	4.0	3.0	17.0	9.0	14.0	8.0	7.0	6.0	15.0	8.0
Turbidity (NTU)	10.50	2.63	1.26	3.11	1.18	1.59	0.86	9.76	10.40	44.40
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
15 JAN 2021
DEPT. OF CIVIL ENGINEERING
P.O. BOX 32379 LUSAKA

Tested by: D. Mkandawire ..... Checked & Approved by: Joshua Liyungu .....
Technician Lab Manager /Co-ordinator

Table 4: Chikowa Dam - Water Analysis Results obtained in June 2020

Element	Chikowa Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[56]
pH	6.76	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	352	1500	
Sulphates (mg/l)	2.50	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	
Total Dissolved Solids (mg/l)	176	1000	
Ammonia (as NH4-Nmg/l)	0.07	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	< 1.0	-	50
Chemical Oxygen Demand (as mg O2/l	4.00	-	250
Chlorides (mg/l)	14.00	250	
Turbidity (NTU)	1.18	5	
Hydrocarbons (mg/l)	< 0.005	-	10

Source: Extracted from Table 3 above

The water quality was found to be acceptable for use as drinking water. All the parameters critical for monitoring purposes were within the WHO guideline limits for drinking water. The phosphate and sulphate levels were also within the statutory requirement, indicating there is little activity around the dam that may contaminate the dam to levels of non-compliance. However, compared with other dams, Chikowa Dam had a higher Conductivity and Total Dissolved Solids when compared with the results from the nine other dams. This could indicate that the Chikowa Dam is more vulnerable to erosion.

Additionally, the 2016 water analysis results also show the same trend in terms of levels of compliance. All parameters were within the statutory limit, confirming the suitability of the water body for use by those living upstream and downstream of the Chikowa Dam.

The 2016 water quality results at Chikowa Dam are presented in the table below. Equally, the results obtained then did show that the water quality in the reservoir was good enough for human consumption and various other uses such as irrigation and as drinking water for the livestock, for as long as the latter is well managed.

Table 5: Water Quality Data Sampled and Analysed 29/03/2016

Parameter	Unit	Value	WHO Guidelines maximum permissible levels for drinking water
Conductivity	µS/cm	120.9	1500
DO	mg/l	5.64	5
pH	-log[H^{+}]	6.15	6.5 – 8.5
TDS	mg/l	60.5	1000
TSS	mg/l	494	-
Turbidity	NTU		5
Chloride	mg/L	25	250

[5] The World Bank, Water Resources and Environment. Technical Note D1, Water Quality Assessment and Protection, 2003, p. 32, accessed at: http://documents1.worldbank.org/curated/en/514141468768597679/pdf/multi0page.pdf.
[6] The World Bank, General Environmental Guidelines, Pollution Prevention and Abatement Handbook, 1998, p. 438; accessed at: https://www.ifc.org/wps/wcm/connect/77a4c571-c743-48a8-9c6d-21d6ce77d017/genenv_PPAH.pdf?MOD=AJPERES&CVID=jqeDiLg.

Parameter	Unit	Value	WHO Guidelines maximum permissible levels for drinking water
SO_4	mg/L	2	250

4.1.6 Seismology

Earthquakes can result in damage to and failure of man-made structures, such as dams. When constructed in areas of high seismicity, dams may pose a significant risk to downstream life and property. Seismic waves may cause deformation of dam embankments, a loss of foundation strength and instability of the dam.

An important input parameter for the engineering design of a dam is the Peak Ground Acceleration (PGA - a measure of earthquake acceleration on the bedrock outcrops). PGA is used to assess the seismic hazard of an area (in terms of probabilistic approach) and is expressed in ***g*** (the acceleration due to earth's gravity) as either a decimal or percentage; in m/s2 (1*g*=9.81 m/s2) or in **Gal**, where 1Gal is equal to 0.01m/s² (1*g*=981Gal).

According to Global Seismic Hazard Assessment Program (GSHA) conducted between 1992 and 1999, the mean PGA value for most parts of Zambia lies between 0.4 – 0.8g with a 10% excess probability in 50 years, corresponding to a return period of 475 years.

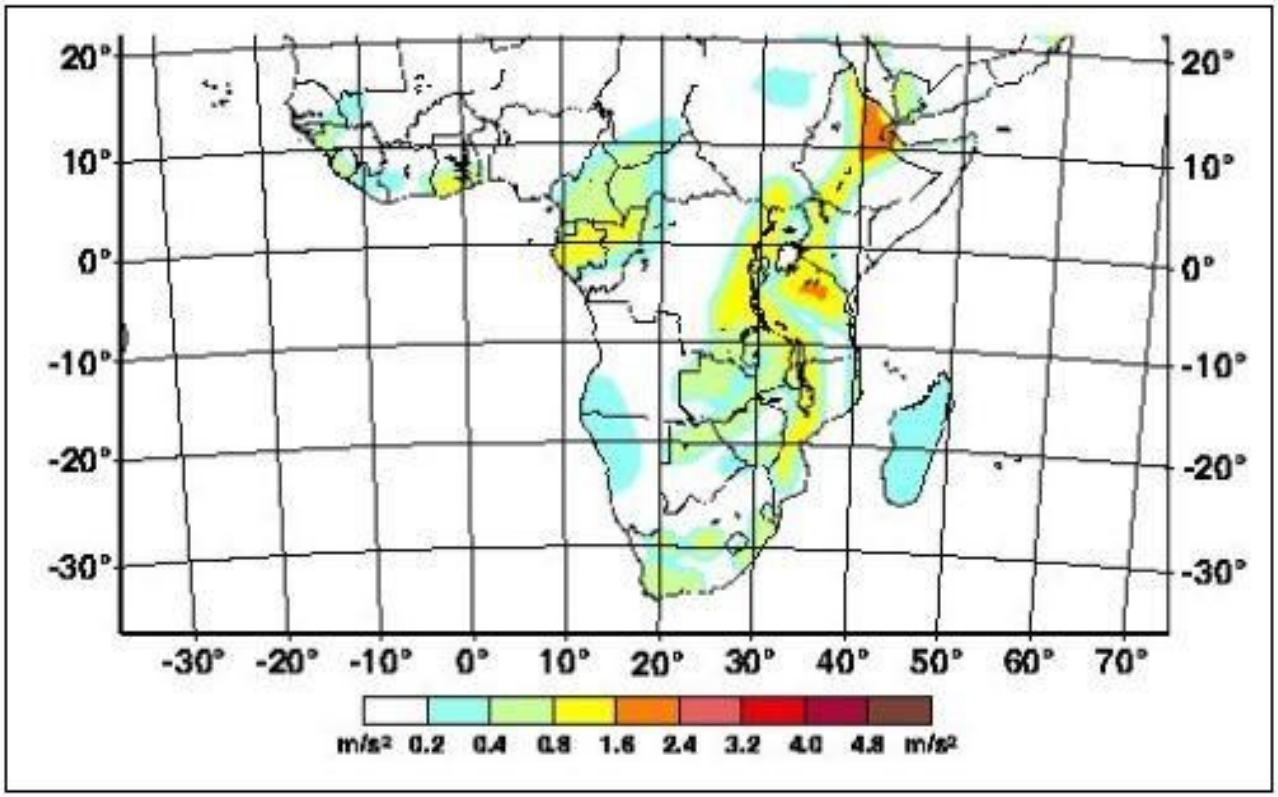


Figure 7: Distribution of mean PGA values for East and South Africa according to (GSHAP*)*

The result of this study was a hazard map, which places northern parts of Zambia in a relatively low zone that exhibits mean PGA values between 0.5 – 0.9g, similar to those of GSHAP. Though the risk may not be high, it may be recommended that seismic hazard be given due consideration in the design of structures such as dams in Mambwe District, for safety reasons. The study particularly recommends that all lifeline and critical

installations and infrastructure, such as hospitals, bridges, dams and electrical power plants should be designed and built to withstand significant levels of seismic action.

There have not been any earthquakes and tremors in Eastern Province and Mambwe District in particular that were significant enough to be recorded as a risk in the area where the dam has been constructed. Though Mambwe District may not be subject to seismic activity, have dam construction, rehabilitation and/or remediation factor in seismic hazard to ensure sustainability of the dam is recommended. It may be consoling to note that correct material is available to achieve a good result that takes care of potential seismic hazards, because geotechnical investigations show that there is no evidence of material that is unsuitable.

Convergence Zone (ITCZ). Mambwe District has average annual temperatures ranging from 6^0C to 15^0C in June and 27^0C to 32^0C in December.

Rainfall Pattern: The annual rainfall compressible, collapsible, dispersive or can liquify) on the dam embankment.

4.1.7 Climate and Climate Change

4.1.7.1 Climate

The climate in the Eastern Province of Zambia, Mambwe District in particular, can be described as humid subtropical, with dry winters and hot summers. As is the case for the rest of the country, three distinct seasons are observed:

(i) Rainy season - a warm wet season from November to April;
(ii) Cold season – a mild to cool, dry season from April to August; and
(iii) Hot season – a hot and dry season from September to November.

The sub-project site lies in Agro ecological Zone IIa, which is characterized by annual average rainfall between 800mm and 1,000mm.

Rainfall:
According to data obtained from four Zambia Meteorological Department (ZMD) stations in Eastern Province, the mean seasonal rainfall from October to May varies between 833 and 1050 mm. Monthly rainfall is distributed over six months starting from October to April. January is the wettest month during the season receiving about 250mm

Temperature:
Taking Chipata as the nearest weather station (about 50km from Chikowa Dam) with long term data and comparable to the sub-project area, the annual mean temperature of the sub-project area is 19.3°C (maximum 32.2°C and minimum 11.8°C)[7]. The average temperature throughout the year is 17°C (Figure 8). The hottest month is October (32.2 °C) and the coldest is July (11.8 °C).

[7] YEC .(1995). National Water Resources Master Plan Study

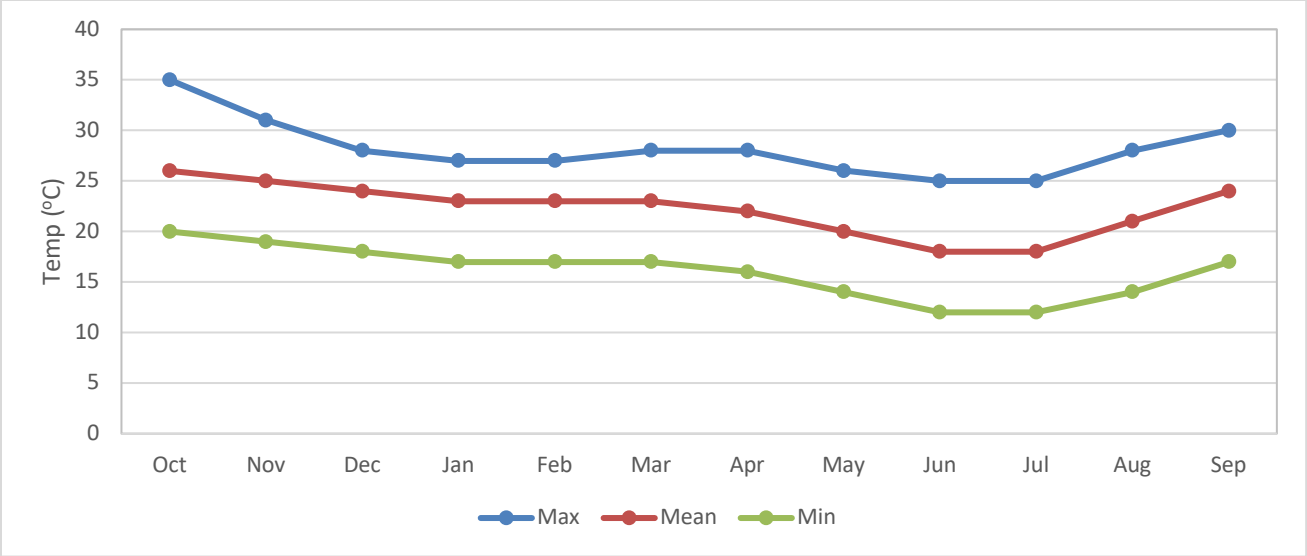


Figure 8: Average temperature per month (1961 – 1990)

Humidity:
Relative humidity varies throughout the year, reaching peak in the wet season. Wet season humidity levels are about 80%, dry season humidity levels are 28%, with mean relative humidity of the area recorded as an average of 60.0%.

4.1.7.2 Climate Change

According to the World Bank[8], Zambia's climate is highly variable and over the last few decades has experienced a series of climatic extremes, e.g. droughts, seasonal floods and flash floods, extreme temperatures and dry spells, many of these with increased frequency, intensity and magnitude. Their impacts on the country are evident in climate-induced changes to physical and biological systems, which increasingly exert considerable stress on the country's vulnerable sectors. The adverse impact of climate change has been on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty, this also limits economic development.

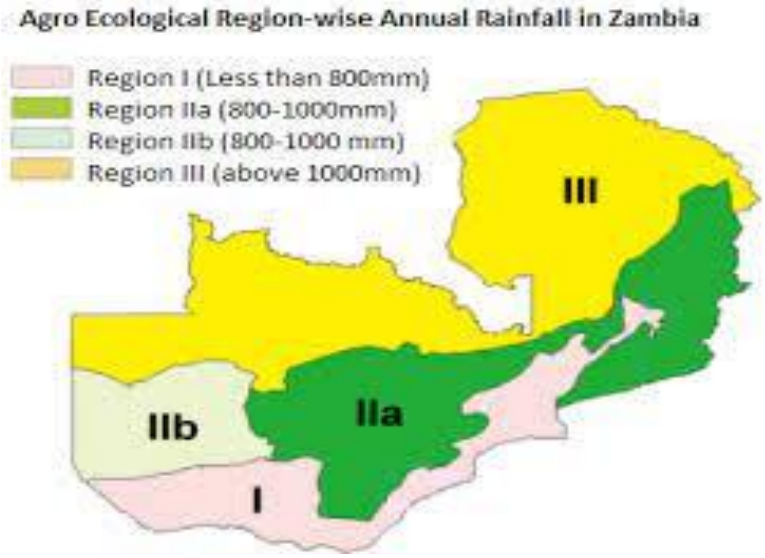
Zambia is divided into three agro-ecological zones with rainfall as the dominant distinguishing climatic factor (Figure 8). Zone IIa lies in the eastern and central part of the country. It receives between 800mm to 1000mm of rain annually. Eastern Province is considered the bread basket of the nation though sometimes experiences unpredictable distribution of rainfall.

The World Bank is funding US$17 million— out of a US$33 million package - for promoting climate-smart agriculture and sustainable landscape management practices in Eastern Province. The Zambia Integrated Forest Landscape Project will support farmers to help them make a better living without increasing the amount of deforestation that Zambia's natural forest is currently suffering from. It aims to do this by helping farmers with fertilizer, tree seedlings, equipment and irrigation[9].

[8] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

[9] https://reliefweb.int/report/zambia/climate-smart-agriculture-solutions-reducing-poverty-and-food-insecurity-zambia

Agriculture is key for the district economy, and depends on rainfall to a very large extent. Eastern Province is one of the food baskets of the country, and climate changes may affect food security in the entire nation. Mitigation measures, such as construction of dams in strategic locations, are well placed to prepare the population of farmers against effects of drought.



The Chikowa Dam may become an important adaptation infrastructure for the near and far communities' water storage and use in a time when climate change is experienced. Climate change projections point to an increase in temperature and a change in patterns of rainfall, leading to prolonged droughts and localized flooding. Zone IIa has rainfall pattern between 800 and 1000mm, which implies the area does make suitable agriculture land.

Figure 9: Ecological Zones in Zambia

Climate change is super-imposed on unsustainable land-use practices, such as forest clearing for agriculture and charcoal production, and combined with poor livestock management systems has caused severe land degradation. The practices affect the dam sustainability. The advantage currently, with the Chikowa Dam environment, is that it has not yet been encroached by subsistence farming. The only threat to the existence of this dam is the structural non-compliances recorded and the major issue being the spillway itself. The communities in Eastern Province depend mostly in agriculture, growing of farm produce, such as maize and sorghum at both small scale and reasonable production for bulk selling.

Climate projections for Zambia[10] are shown in the figures below. The World Bank has used the Coupled Model Inter Comparison Project, Phase 5 (CMIP5) models, included in the IPCC's Fifth Assessment Report (AR5). Key projected climate trends are summarized below:

Temperature

- Mean annual temperature is projected to increase by 1.2-3.4°C by 2060.
- Hot days are projected to increase by 15-29%. Hot nights are projected to increase by 26-54%.

Precipitation

- Projections of mean rainfall do not indicate large changes in annual rainfall. Seasonally, the range of projections from different models is significant, but indicates decreases in September-November and increases in December-February rainfall respectively.
- The proportion of rainfall from heavy events is expected to increase.

[10] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

Continued changes in climate may mean continuous impacts on biological, social and physical environments around the dam.

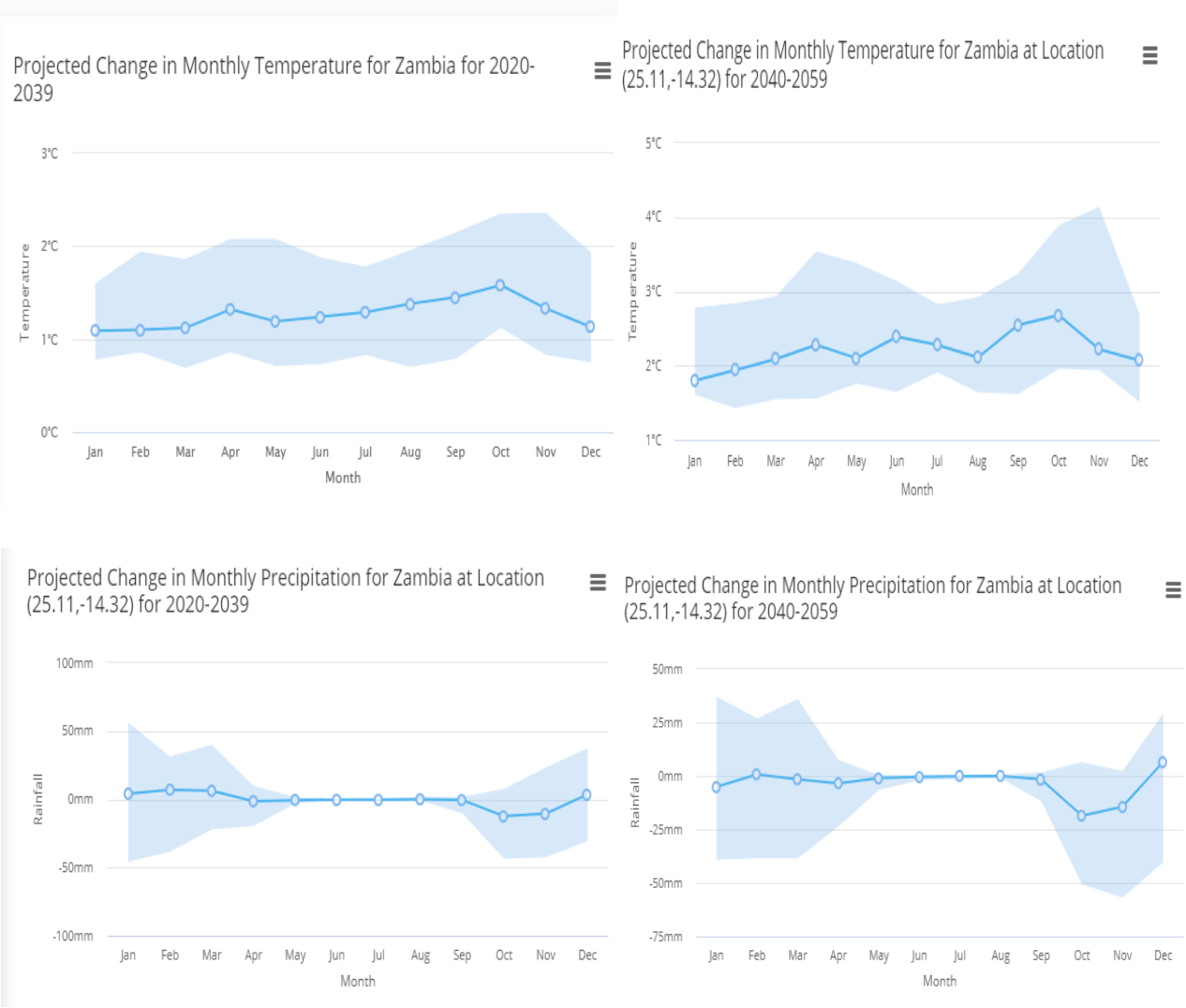


Figure 10: Projected changes in monthly temperatures for Zambia 2020-2059

4.1.8 Land Use and Soil Type

In Mambwe District the two main forms of land tenure are trust land and traditional land. Most of the trust land is reserved forest area. The administrative part of the district is characterized by commerce with small scale and emergent farms in peri-urban areas. A relatively big portion of the district is covered by plains and is used for grazing. The main activities in these areas are basically mixed farming. Cattle rearing is also another form of livelihood in the area.

Community members' sources of livelihood is rain-fed subsistence agriculture (including a wide range of vegetables and some fruit trees), trading and informal wage employment. Some farmers grow cash crops, such as cotton under contract farming. Farmers receive extensive agricultural technical support from NGOs. Most cropping activities are limited to the riverbanks, which expose them to the risk of flooding.

Other than growing crops in designated areas away from the dam, the local community rears domestic animals, such as chickens, sheep, goats and cattle. On the north-western side of the sub-project area are some few fields which do not have any impact on the quality of water as they are located in the lower elevations compared to where the dam is located. Cultivated crops include maize, millet and groundnuts. Most of the local farmers grow them in an inter-cropping system to save time, land and labor.

4.2 Biological Conditions

4.2.1 Flora

The dam is located in the Zambezian and Mopane woodlands, which are dominated by a mixture of Mopane, Julbernardia, Brachystegia and Isoberlinia tree species. The lower storey of the woodlands consists of vigorous grass cover and other herbaceous species. The upper storey is characterized by large trees with a typical canopy cover ranging from 75% to 90%. Over 200 species of trees and shrubs are listed as occurring or potentially occurring in the district. The study area is not near any gazetted forests or protected area. The nearest being Luangwa National Park, which is in Mfuwe District, approximately 50 km away. The area south-east of the dam is predominantly natural, which may be due to the poor and rocky soils, which limit their suitability for cultivation. Downstream, and between the Kasenengwa and a seasonal tributary, cultivation has resulted in clearing of natural vegetation. These are the areas that are farmed by Chikowa villagers.

Plate 6: Vegetation in the Project Area.

The following aquatic plants are found in the nearby stream: Andropogon schirensis, Hyparrhenia spp., Loudetia simplex, Miscanthus teretifolius, Monocymbium eresiiforme, Themeda triandra and Trachypogon spicatus, Ascolepis anthemiflora, elata, Bulbostylis cinnamonzea, Cyperus esculentus, platycaulis, Fuirena pubescens, Kyllinga erecta, Mariscus deciduous, Pycreus aethiops and Scleria bulbifera.

Table 6: Local Flora Species

Species Name	Local Name (Type)
Colophspermum mopane	Mopane (Mpondo) Tree
Peltophorum africanum	Mwikalankanga (Tree)
Erythrina abyssinica	Muvunguti (Tree)
Albizia versicolor	Musasengoma (Tree)
Brachystegia boehmii	Musamba (Tree)
Brachystegia spp.	(Tree)
Julbernadia paniculata	Mutondo (Tree)
Bamboo	(Grass)
Syzygium cordatum	Mufinsa (Tree)
Syzygium guineense	Mufinsa (Tree)
Albizia adianthifolia	Kapentansofu (Tree)
Diplorhynchus condylocarpon	Mwenge
Dichrostachys cinerea	Kansalonsalo (Tree)
Parinari curatellifolia	Mupundu (Tree)
Strychnos cocculoides	Kasongole (Tree)
Combretum celastroides	Mutala, Mutetya (Tree)
Anisophyllea boemhii	Mufungo (Tree)
Strychnos pinosa	Kaminu, Sensa, Musayi (Tree)
Pterocarpus angolensis	Mulombwa (Tree)
Terminalia sericea	Mulilankonko (Tree)
Diospyros mespiliformis	Muchenja (Tree)
Vitex doniana	Mufutu (Tree)
Albizia antunesiana	Musase (Tree)

Plate 7: Vegetation in the riparian regions

4.2.2 Habitats

The distribution of vegetation around Chikowa Dam can be divided into three zones:

Part 1- Upstream of the dam basin: There was no cultivation observed in the immediate sections of this area. The habitat has been disturbed mainly by cutting down of trees. The local community will need to be sensitized through Ministry of Agriculture not to contaminate the Kasenengwa River with fertilizer runoffs, if they have to practice agriculture activities in the vicinity if the river, otherwise this may affect quality of water in the dam and finally affect source of water for the entire Mambwe District and those living in the downstream sections of the dam.

Part 2 – In the dam basin area: The area is depleted of vegetation, as the habitat functions changes from terrestrial to aquatic species in the reservoir. Overall, habitat integrity in the dam has regenerated over time to form part of the aquatic ecosystem.

Part 3 – Downstream of the dam basin: The area is depleted of trees and covered with scanty vegetation. This is the area that is currently disturbed by poor set up of the dam's spillway causing erosion of the river banks downstream. It is hoped that the area will be covered by the irrigation canal once rehabilitation works are completed. Presently there are no gardens or small scale farming in the region.

In summary, the north-west of the dam; and on the lower part of the transect have some reasonable amount of grass. It has undergone minimal human influence (only about 10%). There are no signs of agriculture activities there. There is no gazetted forest or protected areas near Chikowa Dam, except the Ngoni Reserve about 10km south east of the dam.

The distribution of vegetation cover is as shown in the google map below.

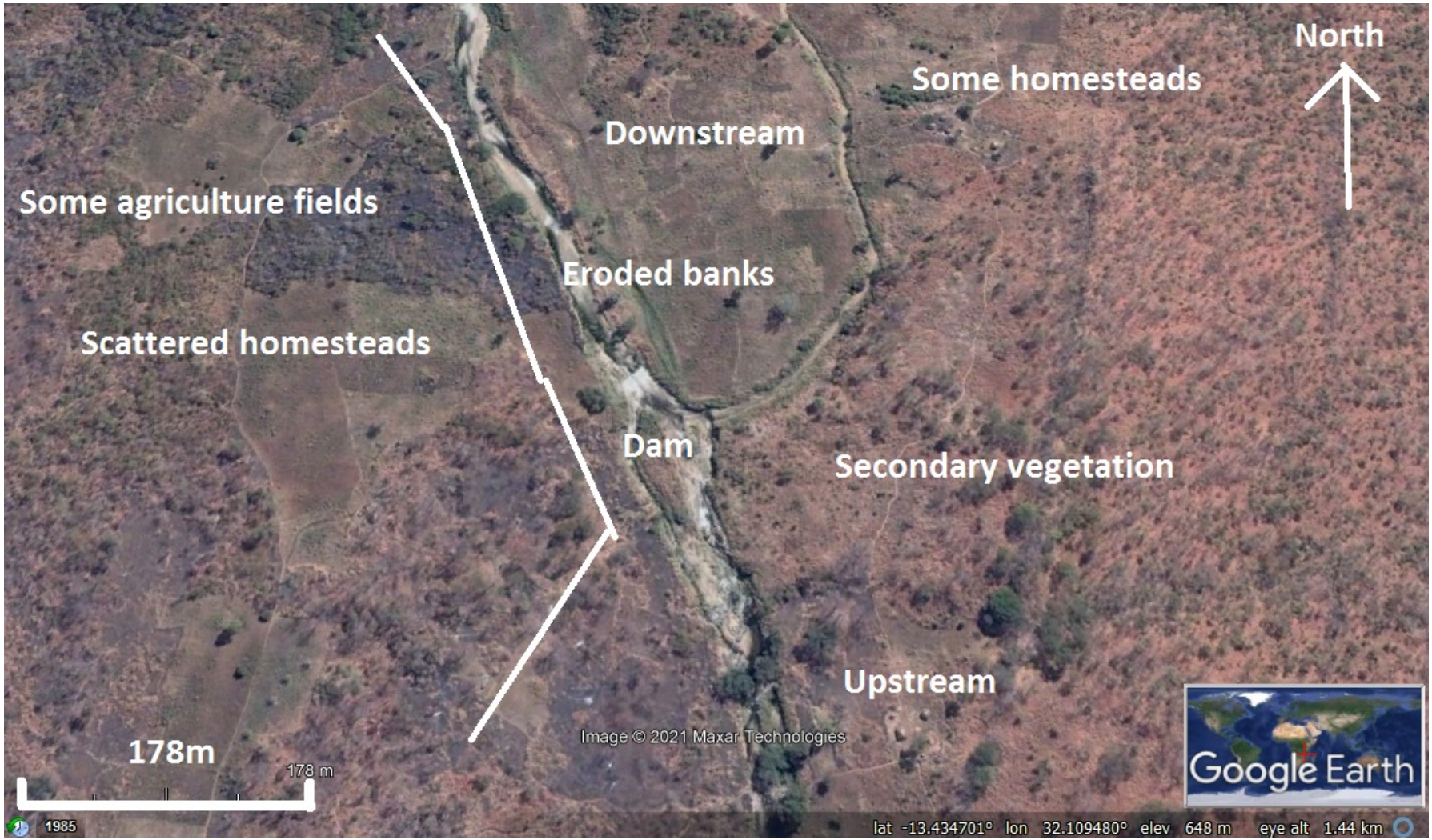


Figure 11: Google map showing vegetation cover around Chikowa Dam

4.2.4 Fauna

An assessment of the fauna in the sub-project area, including aquatic species, was conducted and a biodiversity assessment and subsequently the BMP were prepared and annexed to this document. In the meantime, some of the species listed in the previous studies include those discussed below;

4.2.4.1 Fish Species

The Luangwa River plays an important role in the natural stocking of fish for its tributaries and sub-tributaries. Characteristic of fresh water fish, they swim into smaller streams during breading times and then back into the rivers. They leave some of the young fish in the breeding grounds. The table below shows the types of fish that are found in the Kasenengwa Stream at present. According to locals, there was a lot of fish in the dam last year; due to the abundance of water - until the spillway erupted. Most of the fish escaped rendering the dam with few fish.

Table 7: Fish Species

	LOCAL NAME (Chewa)	SCIENTIFIC NAME
1	Chis'use	*Marcusenius macrolepidotus (Peters, 1852)*
2	Chis'use	*Marcusenius macrolepidotus*
3	Matemba	*Barbus anectens*
4	Matemba	*Barbus barotseensis Pellegrin, 1920.*
5	Matemba	*Barbus lineomaculatus*
6	Matemba	*Barbus brevipinnis*
7	Matemba	*Barbus unitaeniatus Gunther, 1866.*
8	Matemba	*Barbus barnardi*
9	Matemba	*Barbus poechii*
10	Matemba	*Barbus eutaenia*
11	Njuluwa	*Labeo altivelis*
12	Mpumbu	*Labeo cylindricus Peters, 1852*
13	Mpumbu	*Labeo cylindricus*
14	Mp'ata	*Schilbe intermedius*
15	Kaponta	*Heterobranchus longifilis*
16	Kaponta	*Clarias ngamensis*
17	Kazi'yi	*Synodontis thamalakanensis Fowler, 1935*
18	Pende Silusilu	*Hemichromis elongates*
19	Pende	*Sargochromis codringtoni*
20	Pende	*Sargochromis carlottae*
21	Pende	*Oreochromis niloticus*
22		

Source: KI; community consultative meeting

(COWI Report, 2018)

Some fish species, such as Bottle fish; Mukupe [C); (*Mormyrus lacerda Castelnau*), Tiger fish; Mucheni [C]; *Hydrocynus vittatus*, Mulobela [C]; *Ptrocephalus catostoma* (Gunther, 1866), used to be found in Kasenengwa Stream. Now they have disappeared due to shallow waters in the stream. It was reported that Chikowa Dam had a lot of Pende, Matebe and Kaponta fish species in 2017 as opposed to 2018. During that period of fish abundance, the fishermen used to make as much as K150 per day from their catch (Source: community consultative meeting). Fishing methods in the area include the use of nets, hooks and traps. The use of mosquito nets and fish poison is prohibited in the area. The biggest problem cited by community members is

the lack of use of proper sized nets at any given time. All sizes of nets ranging from 1, 1.5, 2, 2.5 to 5 inches are used spontaneously.

Use of the Integrated Biodiversity Assessment Tool (IBAT)[5] as an adjunct to screening level assessment shows 26 potentially occurring Red Data species - 5 mammal, 14 bird, 2 fish and 5 plant species - within a 50 km radius of the dam site. Most of these are likely to have been recorded in the protected areas, which are all Forest Reserves (FRs). Twenty-one FRs occur within the 50 km buffer, with the largest being the Lamba Headwaters FR, the Kafue Headwaters FR, the Kisangwa, Lushishi, and No. 39 and 44 FRs, having a combined area of around 5,000 km^2. The boundary of the Lamba Headwaters FR is within 2 km of the dam. Most of the FRs in this area have been severely encroached in the past decade, only 40-50 km south and west of Chingola and Kitwe, which are major towns. Five endemic fish are known from drainage systems (pers. comm. W Aken, March, 2020) as well as the two vulnerable Red Data cichlid species, recorded by IBAT. Both of the cichlids are threatened by *O. niloticus,* which has been introduced into Zambian river systems by anglers and aquaculturalists[11].

Table 8: Table showing identified fauna (Mammals) using IBAT

Species common names Mammals	Scientific names	IUCN status
Black rhinoceros	*Diceros bicornis*	CR
African wild dog	*Lycaon pictus*	EN
Giraffe	*Giraffa camelopardalis*	VU
Hippopotamus	*Hippopotamusamphibius*	VU
African elephant	*Loxodonta africana*	VU
Lion	*Panthera leo*	VU
Leopard	*Panthera pardus*	VU
Temminck's pangolin	*Smutsia temminckii*	VU

[11] World Bank Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia, April 2020, Page 33-47

Table 9: Table showing bird species

Species common names Bird species	Scientific names	IUCN status
White-backed vulture	*Gyps africanus*	CR
Hooded vulture	*Necrosyrtes monachus*	CR
White-headed vulture	*Trigonoceps occipitalis*	CR
Steppe eagle	*Aquila nipalensis*	EN
Madagascar pond-heron	*Ardeola idae*	EN
Grey crowned crane	*Balearica regulorum*	EN
Egyptian vulture	*Neophron percnopterus*	EN
Lappet-faced vulture	*Torgos tracheliotos*	EN
Tawny eagle	*Aquila rapax*	VU
Southern ground-hornbill	*Bucorvus leadbeateri*	VU
Wattled crane	*Bugeranus carunculatus*	VU
Blue swallow	*Hirundo atrocaerulea*	VU
Martial eagle	*Polemaetus bellicosus*	VU
Secretarybird	*Sagittarius serpentarius*	VU

4.2.5 Ecosystem Threats

As indicated before, there is no gazetted Forest or protected areas within 1km radius. However there are a number of Forest Reserves in Mambwe District, the nearest being the Lamba Headwaters Forest Reserve, which has its boundary not more than 2 km from the dam.

The habitat environment around the dam needs to be protected. The areas somewhat rich in secondary vegetation must be preserved and the areas depleted must be conserved going forward to promote re-vegetation. The community will have to be continually sensitized in order to protect the environment around the dam.

A biodiversity assessment was completed and a BMP developed and annexed to this document, providing measures required to mitigate particular biodiversity impacts.

4.3 Socio-economic Conditions

4.3.1 Location and Demography

The dam is located about 15 kilometers from the Mambwe district administrative centre. The area falls in the Chikowa Ward, under the jurisdiction of His Royal Highness Chief Jumbe. It has a total population of 4,907 people in 898 households.

The population is concentrated in small to medium sized villages situated along the Kasenengwa River downstream of the dam site. Most of the main housing structures are built with burnt bricks and are roofed with corrugated iron sheets. The transition to relatively modern housing structures has been promoted by many organizations that have provided assistance in the area, such as the NGO CARITAS Chipata. This has happened as part of the promotion of climate resilient infrastructure.

Community members' sources of livelihoods are rain-fed subsistence agriculture (including a wide range of vegetables and some fruit trees), trading and informal wage employment. Some farmers grow cash crops such as cotton under contract farming. Farmers receive extensive agricultural technical support from NGOs. Most cropping activities are limited to the riverbanks, which expose them to the risk of flooding.

The Chikowa area has two major sources of water, namely surface water from the Kasenengwa River and underground water abstracted from boreholes, protected hand dug wells and shallow wells. The area has benefited from domestic water supply programmes through communal boreholes equipped with hand pumps and hand dug wells. The Chikowa Rural Health Centre services Chikowa ward, and serious health cases are referred to the Kamoto Mission hospital, which is about 18 kilometres away in Mambwe district centre. The area has a preschool, a community school, a basic school and a vocational training school.

Figure 12: Google map showing direction to Chikowa Dam

The built environment of the Mambwe town centre is located along the Chipata-Mfuwe Road with buildings housing various Government departments, NGOs, parastatals and private companies; residential houses, churches and other social centres. Other facilities include other commercial infrastructure such as markets, shops and restaurants, warehouses and food storage sheds; telecommunication infrastructure used by MTN, Zamtel and Airtel mobile networks service providers and Multi-choice (Dstv), and water works.

The sketch map above shows the two institutions that are close to the dam: the Chikowa Mission Hospital and the Chikowa Youth Development Centre. Both institutions are located within the 4km radius from the dam, the nearest being the Chikowa Youth Development Centre.

4.3.2 Sources of Livelihood

Most of the people in Mambwe District survive on farming as the area is blessed with fertile soil with maize being the most widely grown crop followed by sorghum and millet. Mambwe District also produces a lot of vegetables and carrots, which are mainly sold at Chipata's market.

4.3.3 Social and Livelihood Conditions Around The Dam

Chikowa Dam has very few community members living close to the dam, and these are found on the south-western side of the dam. Their small scale farming activities are conducted close to their homestead, but away from the dam. The buffer between the homesteads and the river system is almost depleted of the vegetation. Agricultural activities in the sub-project area are of small scale farming which include rearing of domestic animals such as chickens, sheep, goats and cattle. Cultivated crops in the proposed project area include cassava, maize, millet, sorghum, beans, sweet potatoes, and groundnuts.

The settlements are therefore concentrated mostly on the south-western side of the dam and along the road from Chipata through the Chikowa Mission and the Chikowa Youth Development Centre. This is the community that will need to be sensitized to ensure they manage fertilizer use in their field, properly to avoid runoffs from these field from contaminating the Chikowa River (upstream section).

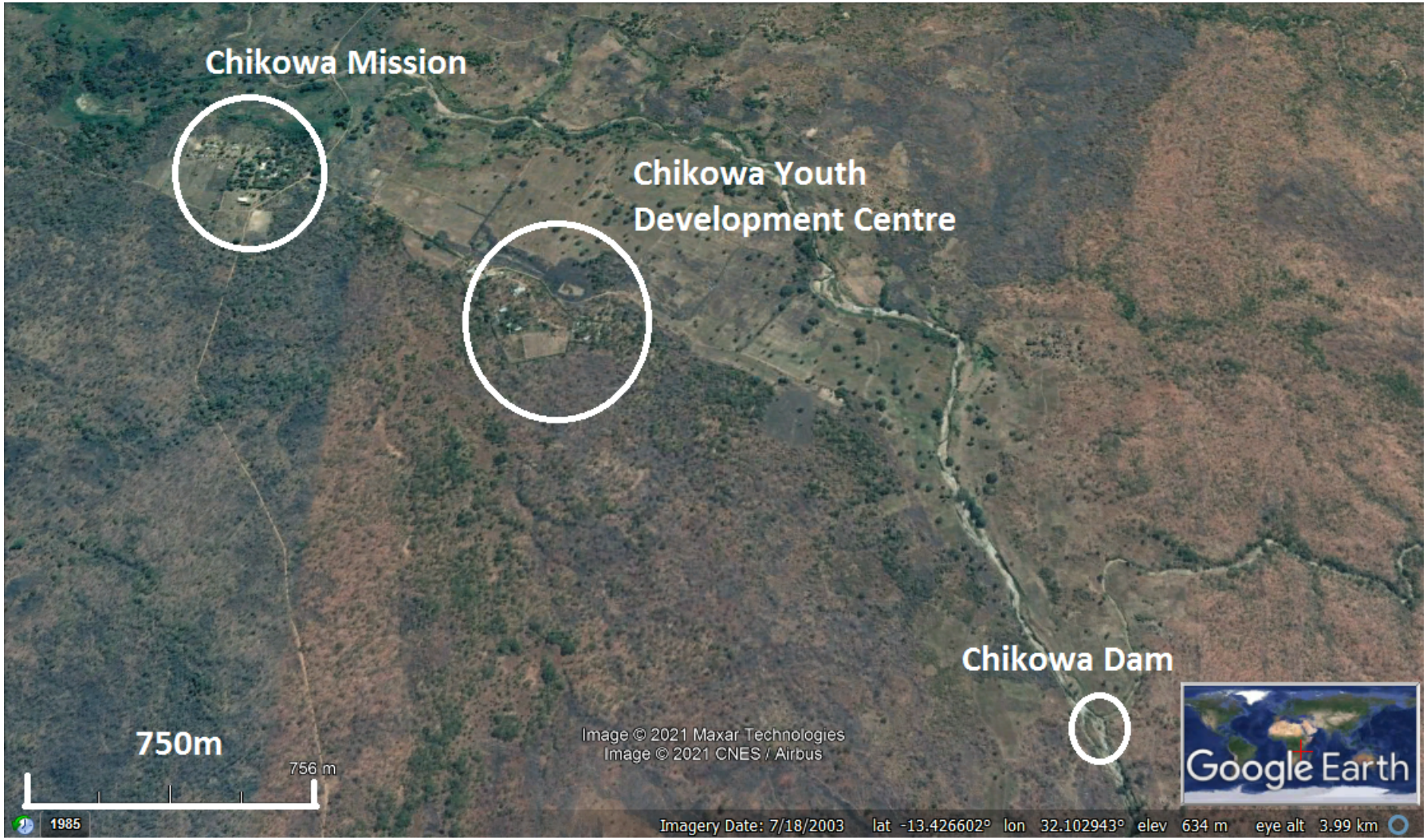


Figure 13: Google map showing some infrastructure close to the sub-project area

The previous contractor had a site office block less than 50m west of the dam. The entire workforce had rented apartments within the local community living close to the dam at the western side of the sub-project area. Water was accessed from one of the boreholes in the local community. The workers also accessed already existing latrines belonging to the local community. Arrangements were made after reaching an agreement with the local community on the same.

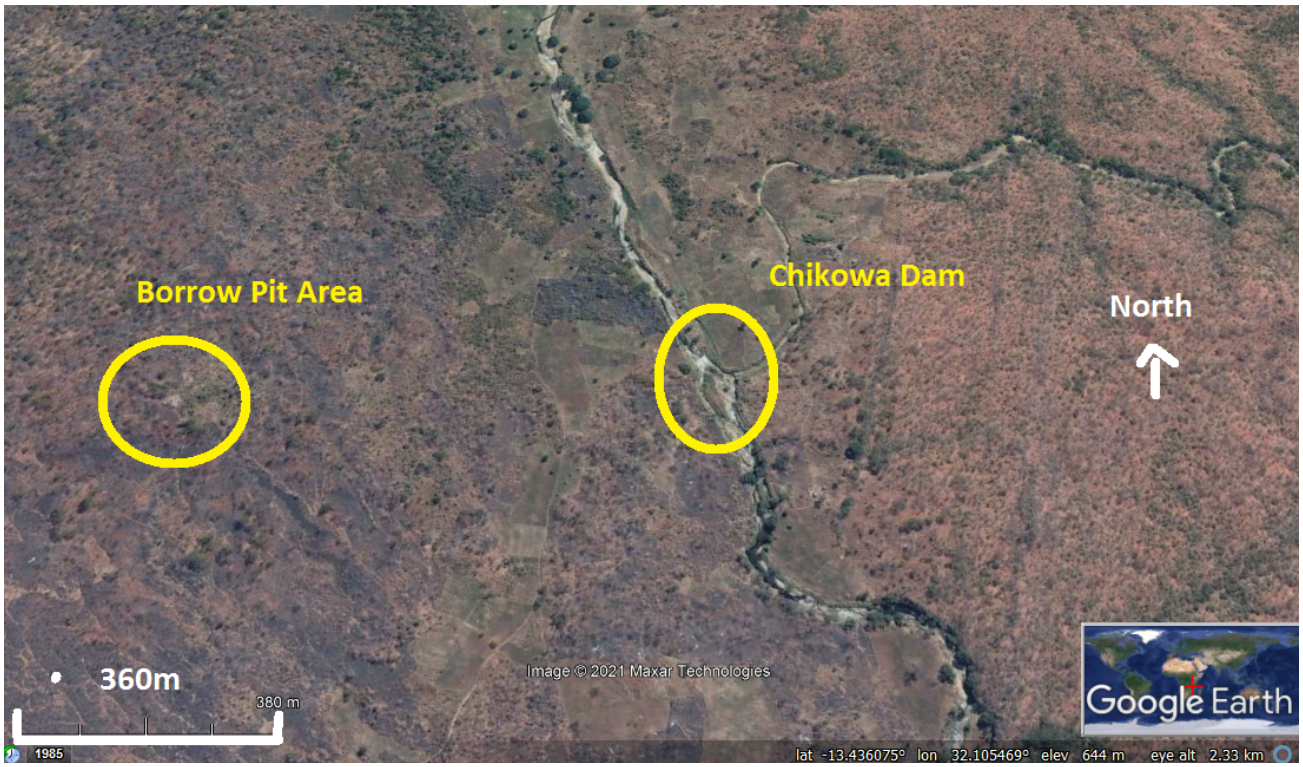


Figure 14: Google map showing the location of borrow areas

4.3.4 Fishing

Currently, the fishermen from the local community fish from the dam, and usually sell the fish to the local community and to some road users. After rehabilitation of the dam, it should be stocked with fish to empower the local community achieve some food security and a bit of income, through selling of fish, for their survival.

4.3.6 Administration of Water and Dam

Chikowa Dam has a DMC in place, though it is not active as yet. The committee consists of 10 members: 5 women and 5 men. The committee is yet to receive training on various topics and to develop a constitution to guide its management of the dam.

Strengthening and capacity building of the existing DMC will ensure that communities benefit fully from the dam, because they will be able to appropriately maintained the facility for years to come.

4.3.7 Gender Equality and Gender-Based Violence/Sexual Exploitation and Abuse

Women at Chikowa are involved mostly in small scale cultivation of vegetable and tomatoes for sale while some of their husband are engaged in cultivation of maize (subsistence farming) and others are fishermen. There are a few men and women that work as house maids and garden boys in the high cost areas.

According to respondents, and common with many other sites, Gender-Based Violence (GBV) exists among the dam communities, but it is usually not reported, as reporting comes with significant social stigma. Generally, an estimate of 1 in 5 women in Zambia experience some form of sexual violence at some point in their lives.[12] In the Demographic and Health Survey of 2013-2014, 43% of women age 15-49 claimed to have experienced physical violence at least once since age 15; and 37% experienced physical violence within the 12 months prior to the survey. 47% of married women of the same age category report to have experienced physical, sexual and/ or emotional violence from their current or most recent husband or partner.[13] Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[14] Other factors contributing to GBV are sexual cleansing rituals, initiation ceremonies, women's economic dependence socialization of boys and girls, inadequate laws, lack of law enforcement, and intimate partner violence.[15] A baseline study conducted by Overseas Development Institute (ODI) in Zambia captured some key definitions of the types of GBV, such as women being beaten (usually by their spouse), men engaging in forced sexual intercourse with young children, women being forced to have sex, mistreatment of children including through labor, forced early marriage, and women's rights being infringed.[16]

The same baseline mentioned as first address in GBV cases the Victim Support Unit in the Police service, although there seems to be doubt in their efficiency.[17] Key challenges for preventing and responding to GBV are that most cases go unreported, because survivors are reluctant to report them. On the supply side, infrastructure, shelters and transport, have critical gaps. In absence of shelters, the safety of survivors cannot be guaranteed. Prevention activities are still not sufficient to have a significant impact.

In April 2011, Zambia passed the Anti-Gender Based Violence Act no.1 of 2011. The Act offers a comprehensive framework for protection, the prosecution of perpetrators, and supports the means of survival for victims. It established a fund to assist survivors; and it called for the establishment of shelters to support survivors, as well as it regulated monetary relief for them.

As a result of the Act, the Government has established 3 shelters across the country; a Police Victim Support Unit, as well as a series of one-stop centers across the country: At Mtendere and Chawama clinics in Lusaka; Buchi Clinic in Kitwe; Chipata Hospital; Mazabuka District Hospital; Livingstone District Hospital; Kabwe District Hospital; Ndola Central Hospital.

UNICEF, Young Women Christian Associates (YWCA) and World Vision have established further one-stop centers and drop-in centers. NGOs provide social services, counseling to victims (e.g. Lifeline Zambia, 24 hrs toll free telephone counseling service).[18] Further services are provided by World Vision, Women and Law in Southern Africa, Zambia Center for Communication Programme. The Project 'STOP GBV Programme: GBV Survivor Services, Access to Justice ended some years ago. A UN Joint Programme on Gender Based Violence, 2012-2016 established an Anti-Gender Based Violence Task Forces in five provinces and at five district levels. It opened village-led one stop shops, trained GBV response groups at the village level, trained community-based care providers in psychosocial care, and established 60 community help desks in districts.

[12] Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1
[13] USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273
[14] Z. Ngonga, Factors contributing to physical Gender Based Violence reported at Ndola Central Hospital, Ndola, Zambia: A case control study, In" Medical Journal of Zambia, Vol. 43.3., p. 145-151, 2016.
[15] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.
[16] Ditto, p. x
[17] Ditto.
[18] Chidoori Rumbidzai, 2011, p. 32

Zambia Alliance for Women's mission is to empower women to take charge of their lives through promotion of Gender Equity and Equality, Environmental Sustainability and Social Justice so that the right to a healthy life is enjoyed by the present and future generation. ZAW has its presence in Mambwe District to educate the women and the under privileged for their right to a healthy life.

Regarding GBV cases, one community member was on hand to admit that they do have incidences of gender based violence and that they did also have the same cases even during the time the dam was being constructed. The community mentioned that there been no system of reporting such cases under the project and all they have been doing is follow the normal channel of reporting to either the traditional leaders or the police for action in the event that their cases require the intervention of any of the two authorities. CARITAS, one of the NGOs has been on hand to provide assistance where this was deemed necessary.

4.3.8 Cultural Environment

Eastern Province is one of Zambia's ten provinces. As of 2010, Chewa speakers were the largest community in the region with 39.7 per cent of the total population and Chewa was the most widely spoken language with 34.6 per cent speaking it. On the tourism front, the province has four national parks. The province has two significant traditional ceremonies, the Nc'wala festival celebrated in Chipata District by the Ngoni tribe in February and the Chewa Kulamba ceremony celebrated in Katete District by the Chewa Kingdom, which is held annually on the last Saturday in August.

Land tenure in the dam basin area is generally traditional, administered by the Chief in the area. As discussed earlier, traditional village settlements are not far off from the dam. Each village comprises of ca. 10 housing units. Depending on the size, a few villages are called sections, and several sections form a ward. The reservoir site, however, has very few settlements in the vicinity.

For the development of this ESMP, stakeholders were consulted, including the Chikowa dam users and district stakeholders (District Commissioner, representatives from Department for Social Welfare, Department for Arts and Culture, Department of Forestry, Department of Agriculture). Consultations were held covering the upstream and downstream communities (650 households) around the dam.

Stakeholders claimed that the previous public works on the dam have not impacted the communities' cultural practices or heritage, and that there are further no significant or historical features in the area.

Stakeholders indicated that graveyards are located far off from the dam and therefore do not anticipate any impacts on their movements to the graveyard once works start. No potential cultural environment and cultural heritage impacts are expected.

Below is the stakeholder population consulted in Chikowa District.

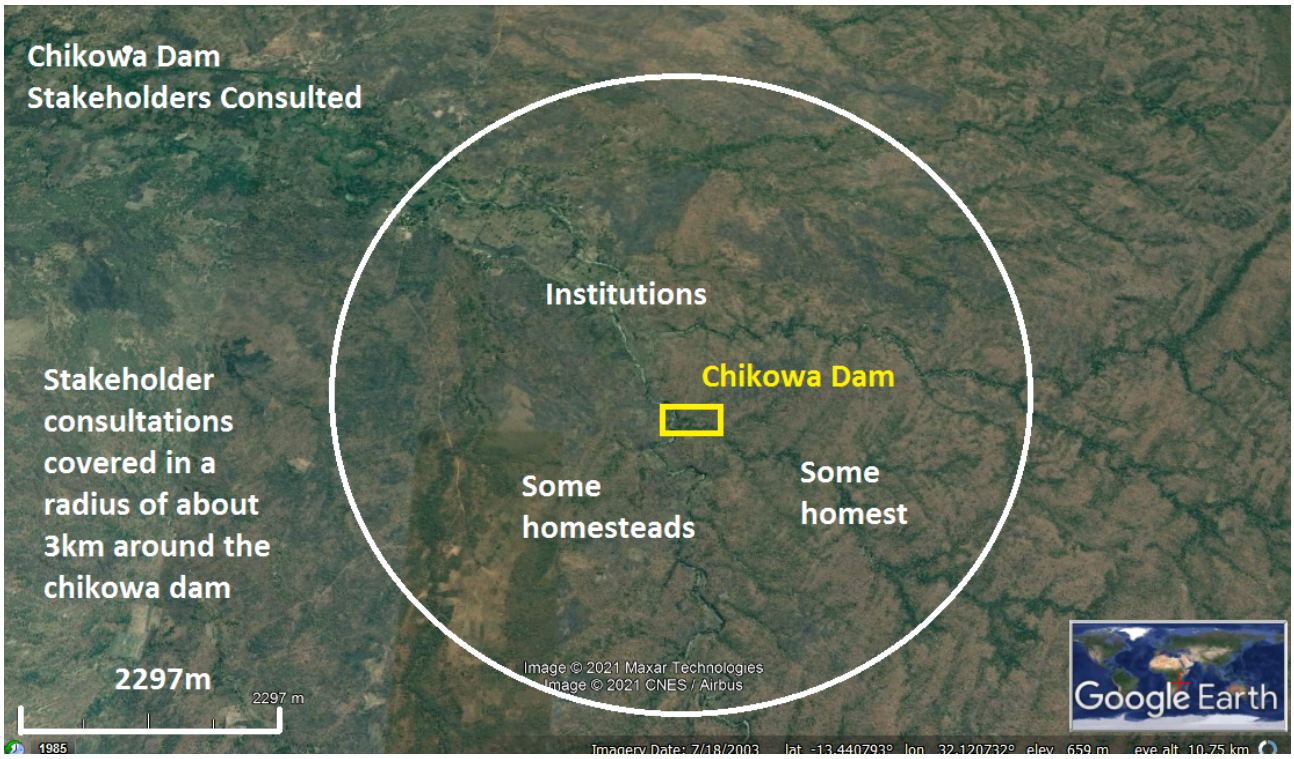


Figure 15: Schematic consultation coverage

5. Sub-Project Characteristics

5.1 Dam Characteristics

Chikowa Dam is an earth dam located in Mambwe District (Chikowa Ward) in Chief Jumbe's area on Kasenengwa River. The GPS of the current dam site are 11° 8'11. 86"S, 28°56'22. 55"E. Chikowa Dam is a new zoned earthfill dam with a gross storage capacity of 773,000 m^3 with a maximum height of 11 meters predicted to inundate 19.1 hectares at full supply level - according to the initial and reviewed design report. Construction of the embankment and spillway is complete, although a few technical improvements have been recommended. There is no irrigation system yet. The envisaged activities are irrigation of 45 hectares of cropland, and aquaculture using fishponds.

The dam is filled by means of runoff from a catchment of 515km^2. The main purpose of the dam is to provide water for irrigation, aquaculture and livestock. Below is the google map showing the location of the dam, with the roads clearly marked.

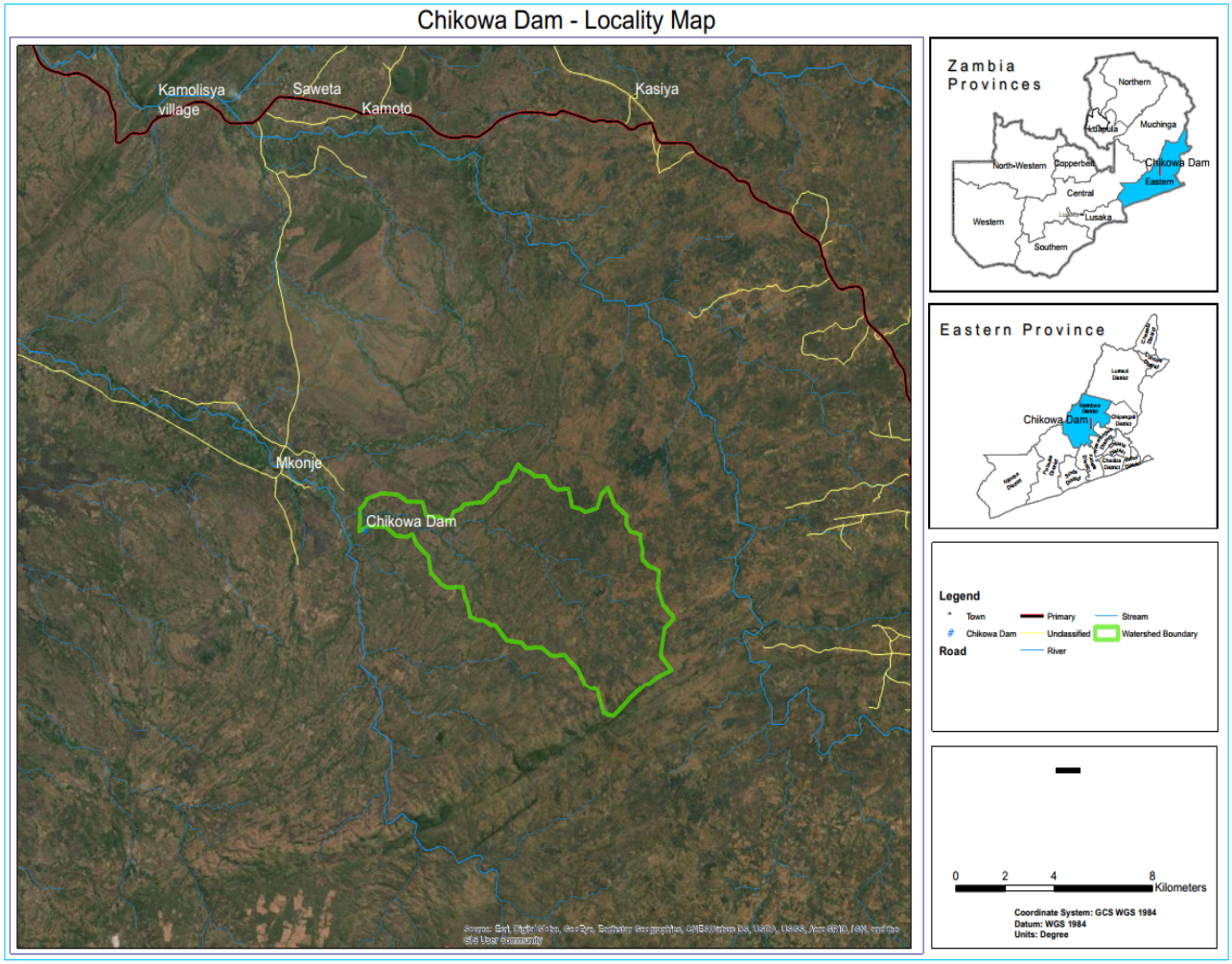


Figure 16: Google map showing location of Chikowa Dam, UNOPS 2021

5.1.1 Dam Catchment Data

Table 10: Chikowa Dam Catchment Data

Source Document	Year	km^2	Method of calculation
Ministry of M E WD	2014	54.8	***Design Report WRDP***
COWI - Aurecon	2018	560	Taken from COWI - Aurecon submission
UNOPS	2020	515	STRM 3D DEM (NASA) and ArcGIS

MAP, MAR and Inflow Data:

- The Mean Annual Precipitation - MAP - for this area is 800 mm.
- The Mean Annual Runoff - MAR - for the area is 5,480,000 m^3
- The MAR used is in accordance with the Zambia National Water Resources Master Plan.

Catchment yield at the site of the dam is 515,000,000 *0.08 = 41,200,000

5.1.2 Dam Capacity

Table 11: Chikowa Dam Capacity

Source Document	Year	m^3	Method of calculation
COWI - Aurecon	2018	41,200,000	Full basin survey - topographic, UAV and bathymetric

Assuming a 80mm MAR the average annual inflow is	***41,200,000*m³**
Current estimated capacity of the dam is	**1,174,118m³**

The site has been developed to only 2.85 % of its capacity which is 35.09 times the current dam capacity.

5.1.3 Sedimentation

With the catchment size of 515 km^2, an assumption of a sedimentation yield has not yet been resolved. This will be updated once the sedimentation yield has been determined by the engineers.

Geotechnical Investigations:
Geotechnical surveys and investigations were conducted to obtain information on the current geotechnical Dam conditions, and on the materials required for the rehabilitation of the Dam. The survey is comprised of:
a) Geotechnical investigation for the Dam.

b) Dam construction material investigation.

The objectives of geotechnical surveys were:

a) To obtain data on Dam integrity.

b) To obtain information for weak foundation countermeasure planning.
c) To obtain latest information/data on possible borrow pits and quarries as well as physical properties of the materials.

The results of the geotechnical investigations will be presented as soon as the current design works are completed.

5.2 Current Embankment and Spillway Status

5.2.1 Embankments and Crest Slope

The original design documents available for Chikowa indicate that the upstream and downstream slopes were given as 2.5:1 on the upstream and 2:1 on the downstream, with a crest width of 4m.

Checks carried out from the recent dam inspection show that the embankment is in good condition.

Plate 8: Upstream slope and rip-rap

- Grassing is sufficient and riprap is functional, slopes are well defined and evenly sloping, on the upstream.

Plate 9: Appearance of repaired gullies on the downstream

- Visual inspections of the downstream showed signs of maintenance repair works where gravel or earth were used to fill small gullies.
- The slopes are uniform, no cracking or settlement was observed.

Plate 10: Dam crest

- The crest shows no signs of breach/wash out, and no settlement either. The shoulders appeared intact, width was uniform, crest was fairly horizontal with no signs of any Repair works.

Plate 11: Crack on Crest

- Cracks were noticeable (un-engineered Embankment) towards the northern end as one approaches the spillway.

5.2.2 Internal Filters & External Drains

A Toe drain exists and appears to be in good working condition. No evidence of contamination was observed on this assessment and further no soft toe condition was noticed around the toe area. No Visible boils were noticed as well as no repair works at toe were noticed.

5.2.3 Spillway, Training Wall and Return Channel with Structures

The main (service) spillway is functional and structurally sound though a few defects were noticed.

Plate 12: Chikowa Dam Spillway

- No emergency spillway is present at this dam.

- Top concrete erosion and spalling was noticed on the spillway. It's understood this was done to correct the level/height of the spillway. This needs to be redone for the structure to fully serve its purpose.

- Minimum seepage occurs in-between the masonry crest and the concrete structure of the spillway. This was also observed around the left abutment of the spillway structure.

Plate 14: Seepage in-between the masonry crest and the concrete structure of the spillway

- Erosion on the banks of the spillway channel was plentiful as shown in pictures below.

The downstream banks along the training wall have been being eroded as seen on areas where sandbags have been placed.

Plate 15: Erosion near the left side of the 1st abutment structure

Plate 16: Erosion on the left bank of the spillway channel (both pictures showing this condition)

Plate 17: Erosion on the left bank of the training wall

Plate 18: Erosion on the ride side bank of the training wall

Plate 19: Eroded side of the spillway outflow channel

Plate 20: Sand bags installed to prevent further erosion of the spillway outflow channel

5.3 Overall Legacy Issues at the Dam

The legacy issues are illustrated below and mitigation measures are discussed in chapter 6.

5.3.1 Structural Risks

Embankment crest and slope stability risks:

- Cracks on un-engineered embankment towards the northern end as one approaches the spillway.

Spillway risks:

- No emergency spillway is present at this dam.
- Top concrete erosion and spalling on the spillway.
- Minimum seepage occurs in-between the masonry crest and the concrete structure of the spillway, and also around the left abutment of the spillway structure.
- Erosion on the banks of the spillway channel.

Training wall

- Remediation works required by cut and fill and reconstruction of the earthworks.

1. Crest	
	
Cracks on Crest of “un-engineered” Embankment	Cracks on Crest of “un-engineered” Embankment
2. **Discharge Structure (Evidence of erosion of the spillway structure)**	

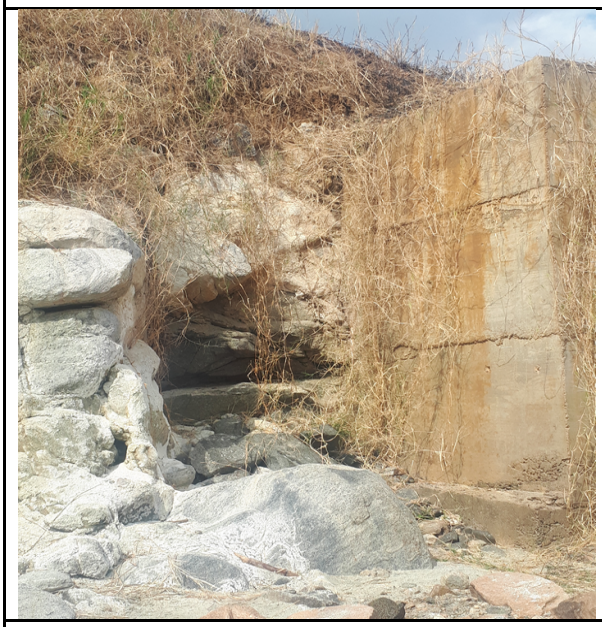
	
Eroded top layer concrete of the spillway	Eroded top concrete of the spillway
3. **Evidence of seepage through spillway structure**	
	
Erosion on the left abutment of the spillway	Seepage between the masonry crest and the concrete structure of the spillway

Plate 21: Status of Crest and Spillway structures

- There is no emergency spillway provided for the dam.

There was minimal seepage between the masonry crest and the concrete structure of the spillway. There was also evidence of seepage action around the left abutment of the spillway structure. There is need to monitor this section prior to making decisions on the final remedial actions.

4. Spillway Return

Erosion on the left bank of the spillway channel

Eroded left bank of the spillway channel

Heavily eroded left bank of the spillway channel

Eroded left bank of the spillway channel

Eroded left bank of the spillway channel

Eroded left bank training wall

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Erosion on left bank of spillway channel</td><td>Eroded spillway channel</td></tr>
<tr><td colspan="2">Recommendation was to install gabion baskets along the bank for some length from the right abutment through the throat. This is to prevent the erosion to continue propagating towards the high land on the left bank where there has been a reports of “human settlement”.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Spillway Channel and right bank training wall</td><td>Eroded right side bank of the spillway channel</td></tr>
<tr><td>  </td><td rowspan="2">Shows sand bags that have been placed on top of the left bank to prevent floods from up land eroding the edges of the spillway channel on the left bank. The sand bags are worn-out and have completely outlived their usefulness and need to be replaced with bags made from stronger non-biodegradable materials for longer service and performance.</td></tr>
<tr><td>Sand Bags installed to prevent further erosion of spillway outflow channel</td></tr>
</table>

<table>
<tr><td> 
Eroded Side of Spillway Outflow Channel. Gabion Baskest on this Side are hereby recommeneded.</td><td>Shows the eroded spillway outfall. This can be widened towards the left bank and avoid cut-back towards the toe. The confluence where the spillway outfall meets an existing stream seemed to extend towards the toe of the dam near the outlet pipe.</td></tr>
<tr><td colspan="2">5. Outlet work</td></tr>
<tr><td> 
Outlet works</td><td> 
Valve for Outlet works</td></tr>
<tr><td colspan="2">The pipe is in functional and fit-for-purpose. However, there’s no Irrigation Lines connected.</td></tr>
<tr><td colspan="2">6. General Training Wall</td></tr>
<tr><td> 
Eroded left training wall</td><td>The training bank was eroded towards the spillway outfall. The earthworks have to be redone to return the bank to good working order. The training wall earthworks need to be redone towards the upstream of the spillway channel</td></tr>
</table>

5.3.2 Environmental, Health and Safety Risks

Construction phase

Demobilization and restoration plan absence risks:

- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of community roads risks:

- Loss of biodiversity

Rehabilitation of borrow pits risks:

- Erosion and sedimentation
- Weed infestation
- Entrapment risk to wild animals
- Failure to rehabilitate causing increased malaria risks and increased risk of children drowning or injury

Environmental flow releases risks:

- Inability to monitor and assess downstream ecological effects of dam operation

Community health and safety risks:

- Stagnant water ponds within the spillway bed can be likely vector breeding areas and may cause drowning risks as the spillway gets deeper and wider
- General serious or fatal incidents/drowning

Access across the river risks;

- Lack of a bridge/crossing with increased risk of community unrest. Engaging the community will be critical

Operation phase

Community health and safety risks:

- Injury or illness caused by lack of knowledge of dam risks
- Lack of capacity to respond effectively to emergencies related to the dam
- Lack of knowledge about actions to take in emergencies
- Serious or fatal incidents/drowning
- Increased prevalence of water borne diseases
- Disturbance / destruction of flora around the project area

The google map below shows the existing borrow pit sites that have not been rehabilitated.

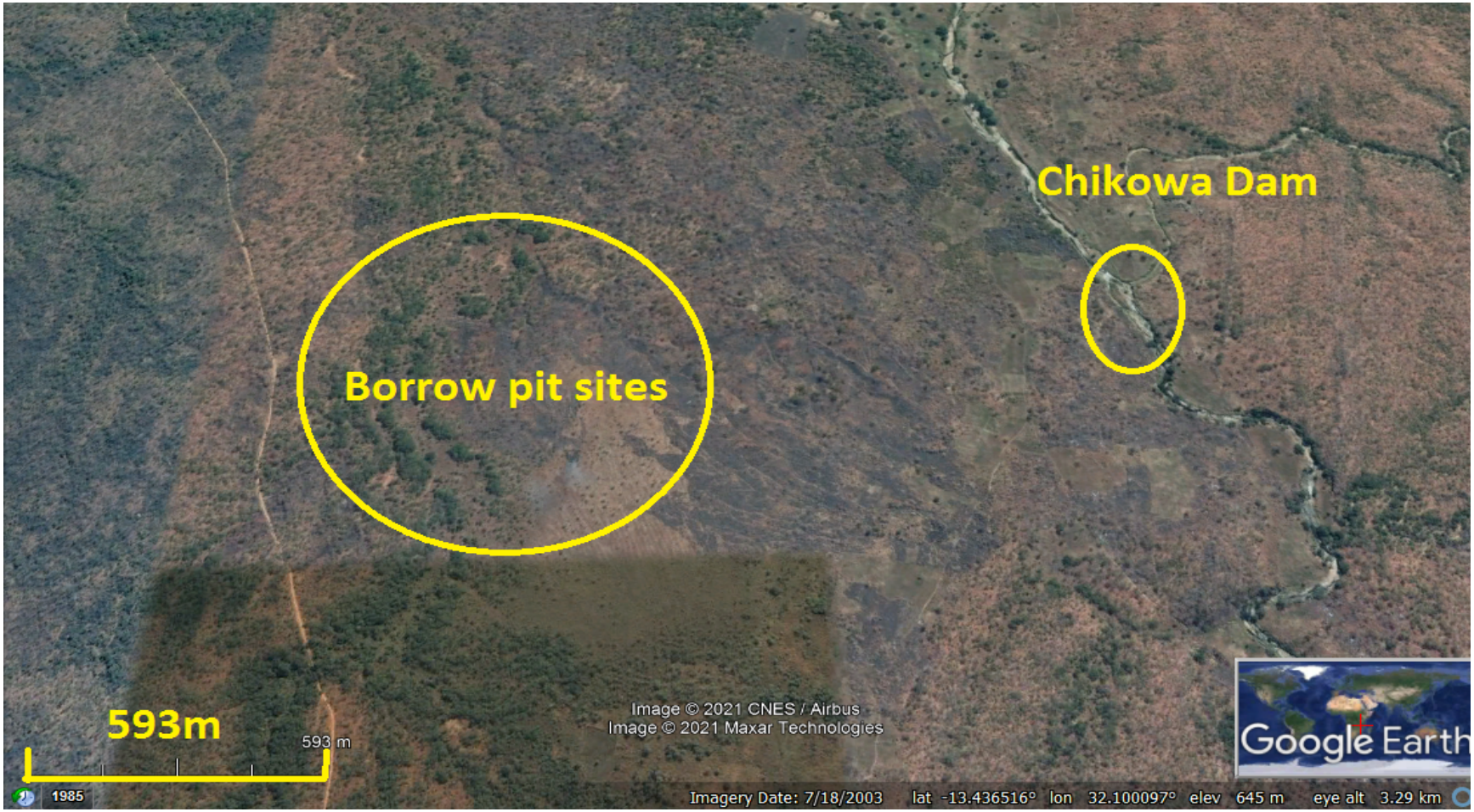


Figure 17: Google map showing position of borrow pit sites at Chikowa Dam

The three borrow pits location are centered around the following coordinates: -13.4398°; 32.09409

5.4 Potential Communities Affected by Works

The rehabilitation of the dam will benefit a population of at least 10,000 persons living within the Chikowa area. Other benefits will include fishing from the dam, access to water by livestock and for irrigation purposes. Within a radius of 100m, there is no significant number of inhabitants north, north-west and north-east of the dam, but there are homesteads and institutions further away from the dam in the north, north-west and south of the dam. There are more settlers along the access road than away from it. There are a few homesteads close to the dam, about 50m to 100m west of the dam, and the number of households does not exceed 10. Further west and south-west of the dam is where about 70% of the Mambwe population live. Most people in the vicinity of the sub-project area are peasant farmers, growing maize, sorghum, etc… while others are fishermen.

Community members consulted indicated that the promise given to them to restock the dam with fish must be honored. However, there will be need to educate this community on the best methods of fishing to avoid another depletion of fish. Those farming upstream will be need to be educated on how to apply fertilizers to avoid downstream contamination of water. The position of the dam currently does not affect any local member of the community. The works to be conducted, which are remedial and rehabilitation works, may affect those living not more than 400m south-west. Those living along the access road and those in the vicinity of the sub-project area may be affected by noise and dust from trucks that will be carrying necessary materials for rehabilitation works.

Currently the Chikowa Dam has some fish, though it is not sufficient for the whole community. The dam is also used once in a while to draw water for irrigation at a small scale. Once completed, the dam will have significant socio-economic benefits, especially the aspect of it becoming the source of water supply for Mambwe residents.

Furthermore, the rehabilitation activities will create temporary local employment activities for the duration of the construction and will therefore benefit both, women and men. Contractors will be required to recruit local workers. The total workforce will be approximately 60 people. 15 of them will likely be the externally recruited, including an engineer, a foreman, site men, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the local communities. Approximately 45 workers will be recruited from the Chikowa communities as first priority before extending to villages far off from the dam. Their tasks will comprise concrete works, work on the embankment, and any other manual tasks. Construction works will approximately take 6 months.

Since the sub-project activities are temporary and the amount of externally recruited workers will be small, there is no significant labor influx expected, including impacts on local resources and services. Similarly, the risk of GBV cases and local level conflicts over sub-project modalities is anticipated to be low. The 15 external workers will likely rent a house or two within the village that is west of the project area. The sub-project area may have a site office which the contractor will commit to demolish after completion of the remedial and rehabilitation works. There may be no need for a workers campsite.

In the case where the contractor desires to access more land than allocated for his work, the contractor will have to engage the local traditional leadership for a piece of land and the contractor will ensure there is a paper signed off for the agreement.

The previous contractor had a site office which was only 40m away. The rest of the workers were local workers coming from their own homes in the throughout the construction period.

5.4 Dam Safety

The dam safety reports for Chikowa Dam include the Emergency Preparedness Plan (EPP) and the Operation and Maintenance document, which will be shared with stakeholders.

The primary goals of an EPP are:

- To ensure that arrangements are in place for an effective response at the scene and, as appropriate, at District, Provincial and National levels to a dam failure emergency;
- To ensure that, for reasonably foreseeable incidents, inundation consequences are minor;
- That potential emergency scenarios are identified and early detection measures are in place to identify the potential failure;
- To take practical measures that mitigate any consequences for human life, health, property, infrastructure and the environment.

It is incumbent on the dam owner to have an EPP in place and to ensure that the dam is safety evaluated, as prescribed, and that site monitoring and documentation are kept up to date by the operator. It is important that there is adequate training of the operator(s) to identify early signs of failure and the correct notification procedures. The emergency preparedness and responses should be established in advance. The plan should be regularly exercised, to make all parties aware of their roles and responsibilities as well as to identify possible flaws in the plans. A notification flowchart is essential for any EPP and the contacts in particular should be updated regularly.

Communication systems must be robust and have back up alternatives - both in terms of contacts and systems. Use of appropriate local languages will be ensured for ease of understanding by local community members. The notification flow chart has been developed in case of an emergency. The DMC and disaster management authorities have a key role in the plan. Training and sensitization of the parties involved will be undertaken prior and during construction works. The inundation maps, affected infrastructure in case of dam break, training plan, reviews and mitigation measures are included in the report. Documentation accompanying the flowcharts includes the following:

- Owners details
- DMC members
- Disaster management authorities chain
- Dam details and documentation
- Inundation mapping
- Preparedness
- Affected infrastructure

The operation and maintenance planning includes the following:

- Components of the infrastructure that require operation and maintenance, for example, replacement of dam components, flow monitoring, monitoring termite invasion, inspecting for leakage along the dam wall.
- A schedule and procedure for maintenance. These include tasks, such as inspections of the components, infrastructure and dam wall, identification of parts requiring replacement, and costing.

- Early warning systems for major maintenance.
- Other managerial, social, institutional and financial tasks such as setting user fees, collecting and accounting for the same.
- Required capacity building.

6. Proposed Remedial Works

6.1 Design Floods

The adopted Design Criteria for this sub-project will be based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods will be checked in comparison with results obtained from the VKE and Pitman. The figures have not been determined yet as the design considerations are still underway. Therefore, a Safety Evaluation Flood has not been determined yet and so are other parameters such as the Maximum Probable Flood rate, the 100 year flood estimates, etc...

6.1.1 Summary table based on surveys

Based on the design criteria and current surveys, some data that is available is as presented below, as spillway details. Those not yet known will remain blank until such a time when the document can be updated.

Catchment Area.	515 km2
Max Probable Flood	___ m3/s
100 year Flood Estimate	___ m3/s
Fetch	___ km
Dry Freeboard	___ m
Service Spillway Width	15.00 m
Current Crest Level	1233.6 m
Spillway Level	1233.99 m
Coefficient of Discharge	____
Current Freeboard	2.00 m
Estimated Raising Required	**-0.45 m**
Est. Freeboard Required	___ m
Revised Crest Level	___ m
Riverbed Level	___
Height of Dam	**8.0m / max ??m depth of water**

The design flood adopted requires a decrease in the current freeboard of **-0.45m**

6.2 Embankment Remedial Design

The designs are not finalized yet. There is however one option under consideration, which includes the construction of an emergency spillway on the western side of the dam.

6.4 Service Spillway, Drop Structures and Training Wall

The designs have not been finalized yet.

6.5 Outlets

Awaiting official data on the new designs to see if there will be on outlets.

6.6 Construction Materials

Construction materials that will be required for the remedial works at Chikowa Dam, will not be far from the following, once it is decided on the remedials and rehabilitation works to be conducted.

- Sand and stone for minor concrete works
- Stone for gabion basket filling
- Rock for rip rap and downstream toe
- Common fill for embankment raising and spillway training wall
- Wearing coarse gravel for roadway on crest - local ZNS gravel pits.

The actual material sites to note and records of the distances from the dam to where the materials will be sourced will be determined by the engineer once the materials required are confirmed and once it is determined that good quality material can be obtained locally.

Subsequent to the above, possible and suitable sources of rockfill, aggregates, earthfill and sand, will be identified by the contractor and approved by the engineer. Before finalizing on the use of the site, it will be the responsibility of the contractor to engage the DMC and the local community in order to get consent from the local leadership on the use of the site as source of raw materials and avoid land and other conflicts Should the sources selected for construction materials prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas and will be expected to go through the same channel of communication with the local persons/authority and consultations with the local community before use of the identified source. The designation of certain areas as borrow areas does not imply that all the materials within that area are suitable for use in the dam embankment. The engineer's representative will indicate which materials from within the general borrow areas are to be used in the embankment and which are to be left unused. Payment for winning and use of materials from any new sources will be at rates to be negotiated on the basis of existing tendered rates. It will be the contractor's responsibility to ensure that only suitable materials are taken from the approved sources.

Rockfill and Aggregate: The rock requirements for the dam has been concrete aggregate, placed rockfill for the embankment slope protection and the downstream toe, rock pitching of the downstream and upstream slopes, gabion baskets infill, coarse filter zones in the embankment, and rock for masonry and for backfill where specified or ordered. This will be confirmed by the engineer.

Concrete aggregates will be obtained from ZEMA approved quarry sites or from an approved commercial supplier identified within Mambwe District or nearby, provided it is is economical. In some cases the Contractor would set up their own crushing and screening plant. However, the later process may take longer to approve by ZEMA since this will require preparation of an EPB for the proposed activity at the proposed location The contractor must arrange for petrographic testing and crushing value testing of the

material he proposes to use, at his own cost, and must submit adequate proof that such material is not likely to lead to long-term deterioration of the concrete. The contractor must also ensure consistency in the quality, grading and properties of the material to be used as concrete aggregates. Further testing may be requested by the engineer, in the event that the consistency is considered to be divergent from the original samples and will be to the cost of the contractor.

The rock sources for the dam have not been identified and will probably have to be obtained from the nearest commercial source or by commissioning local communities to collect suitable rock from suitable surrounding areas.

In addition, the contractor should locate a suitable quarry site to open and possibly operate. If the engineer considers that suitable rock from the required excavations, including overlying boulders, has been wasted by the contractor, he may order the contractor to make up such assessed losses with rock from any other source approved by the engineer's representative at the contractor's own expense. Coarse filter material, as specified in the contract documents, will be obtained either as a crusher-run product or by winning and screening, and if necessary washing, local deposits of gravely material.

Earthfill: Suitable material for use in the rolled earthfill of the dam has not been extensively located. Limited test pits will be proposed and detailed information will be indicated in the Materials Report.

No materials will be taken for any purpose from within two hundred meters upstream or downstream of the dam centerline, nor within fifty meters of the flood embankment, except for those materials won from necessary excavations as directed by the Engineer's Representative.

Sand: Sand will be required for the concrete and masonry and as filters in the earth fill embankments.

It should be noted that it will be necessary to blend pit sand with river sand for use in concrete and for masonry mortar. The contractor will be responsible for locating suitable deposits prior to tendering thereof for approval by the engineer's representative.

Overhaul of Materials: There is no provision for the payment of overhaul of earthfill, gabion rock infill, rockfill or of concrete coarse aggregates and crushed filter material, and tenderers will include for the full price of bringing these materials to the works from those areas designated for use in these documents, or from such other sources as may be selected by the contractor.

Transportation of raw materials: This activity will be well defined once the sources of raw materials are known. When transporting sand, quarry and gravel over a long distance and passing through a settlement, the transporter will be required to cover the material with a tarpaulin and will use a defined route from the source to the construction site.

The social amenities required by the contractor include (see social conditions section of the ESMP):

Water supply: The contractor will provide temporary potable water storage facilities and connection to the existing local borehole within the village, without compromising community access to the water. Water from this borehole will be tested and if safe for drinking can be used by the contractor and its staff.

The contractor will provide the following for the campsite:

- Washing and sanitation facilities- incl. mobile toilets or VIP latrines to be present on site, since most workers will be coming from nearby local community. The site office must be equipped with the necessary sanitation facilities. VIP latrines if they have to be constructed will be within the site for ca. 40 workers (at least 2 latrines, 2m x 3m per toilet with opposite/alternate access and a privacy screen, one for men and one for women). Each toilet will have a hand wash basin.
- Waste management (non-hazardous waste)- collection from waste receptors within the site, and disposal at council designated site located in Mambwe District as will be guided by the local authority.
- Waste management (hazardous waste)- collection within the site under stipulated conditions in the ESMP table. Remediate where necessary or dispose of as per regulations.
- Any hydrocarbon storage facility will require banded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- If temporary accommodation facilities for the staff will have to be built, the facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- Site office facility, a minimum space of 3m x 3m internal dimensions complete with air conditioning, an office table, at least 2 chairs, a common sink, internet, power connection with at least 1 dedicated power point.
- Vehicle and machinery parking area.

Access roads: Access to Chikowa Dam is by a small gravel road, not more than 3km from the main M18 road, as shown in the location map of this dam.

Labor force: The total workforce may be around 50 people. 15 are likely to be externally recruited, including an engineer, a foreman, sitemen, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the local communities. Approximately 35 workers will be recruited from the Mambwe communities.

Additionally, the contractor will ensure to the extent possible that the camps are made from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop down toilets, generator set for energy production will be established. To ensure that the camps are kept small, the employees will be obtained from the local people who will be coming from their own homes. The sites for campsites have not been identified. The Contractor will make his own arrangements for a suitable site for his camp, after thorough engagements with the relevant persons within the local community. Once concluded with the local community and its leadership as well as the local authority, the contractor is expected to provide a full report to the engineer, informing him of where they will finally set up their site camp(s). It will be the contractor's responsibility to ensure the identification and subsequent operation of the camp meets the national and WB standards.

6.7 Construction Programme

To be updated once the designs are officially launched.

7. Risk and Impacts Mitigation Plan

This section provides the following.

- common construction works management plans,
- monitoring requirements
- aspects requiring rehabilitation, and
- rehabilitation management plan for non-structural items.

The contractor is expected to operationalize these plans with details of respective method statement for proposed measures to comply with the safeguards requirements.

7.1 New Remedial Works General Construction Works Management Plan

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Campsite Construction activities	Solid waste generation and releases into the environment Public health and safety hazards	• The contractor will screen the proposed campsite area and should prepare a waste management plan for the site preparation, construction, operation and decommissioning. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work site, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and detailed waste transport method with disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The waste handling procedures and PPE requirements will be detailed in the method statement/ plan.	Construction Phase Daily	• Properly designated waste collection and disposal points • Training/ sensitization records for 100 % of staff • Waste disposal records and logs • 100% cleaned up sit	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month
Hazardous Waste Management						
Construction activities	Hazardous waste generation and releases into the	• The contractor will screen the proposed storage areas and prepare a plan for the site preparation, construction, operation and	Construction Phase Daily	• Properly designated waste storage, collection and disposal points	Contractor Engineer and HSSE Officer	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Vehicular operation **Sanitary facilities**	environment such as hydrocarbons and sewer Public health and safety hazards	decommissioning, as part of a Site-Specific Hazardous Waste Management Plan. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work sites, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The contractor will produce site specific waste management plans and conduct regular waste segregation sensitisation of workers. • The contractor will dispose of hazardous materials at the Council/ ZEMA approved disposal sites. All bulk hydrocarbon storage tanks must be contained in a concrete bund that can accommodate 110% of the total volume of the product that is stored in the tank, with a concrete floor and no drain outlet. Any rainwater collecting in the bunded area that does not evaporate within a short		• Temporary storage areas for hazardous wastes concrete-lined and bunded • Treated contaminated sites, 100 % • Training/ sensitization records, 100% of workers • Waste disposal records and logs available • 100 % of sites are cleaned up • 100% of sites specific waste management plans exist	UNOPS/ IDSP	

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		time must be pumped into drums for disposal through concrete-line mechanical oil separators and the oil recovered and temporarily stored in a waste oil collection tank or sealed drums. The fuel dispensing pumps must also stand in a concreted area, with drains to an oil interceptor. • The contractor will not wash vehicles in the sub-project area, to avoid contaminating the surface water with oil leakages from the vehicles.				
Soil Management						
Excavation activities during proposed dam rehabilitation, material sources extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilization leading to erosion and	• Following acquisition of relevant permits from local council and ZEMA, the contractor will prepare borrow pit method statements and management plans for each site to detail the operation of the site and compliance with the ESMP. • The contractor will limit excavations and clearing to necessary worksites. • The contractor will ensure that site installation, excavations and any other soil movement activity are not done during the rainy season to avoid erosion of material and gully formation. • A depth of utmost 2.5m will be	Construction Phase Daily	• Minimized land and soil disturbances at the work sites • Suppressed dust levels and soil movement / erosion • All sites are soil stabilized sites • Separate soil stockpiles to specification • Drainage and run off control • Site restoration, 90% for regeneration • Site Method	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 3000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
	land subsidence Road surface instabilities	excavated from new borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope and indicated in the method statements. • For a new borrow site area, which is approved by the Engineer, the contractor will seek approval for use of the site as source of construction material. The caution here is that obtaining a permit may take not less than 2 months and hence the need to identify already existing sites and develop plan for managing the site. • The contractor will create and maintain topsoil stockpiles. Topsoil depth ranges will be between 150 mm and 500 mm. The exact depth will be determined from the geotechnical site assessment. Topsoil will be stripped and stockpiled away from other materials. Topsoil will be used only for reclamation purposes when pit operation is complete. • The Contractor will incorporate drainage construction and runoff control at sites. Overburden soil will be used as a perimeter berm to direct drainage on the site or stockpiled separately from topsoil. • The Contractor will rehabilitate and		Statements and management plans prepared • Re-vegetation plan in place in collaboration with local forest officer.		

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		restore sites after remedial works. This will include rehabilitating disturbed work areas and restoring as close as possible to original contours. Restore topsoil from stockpiles. Overburden soil can be used for landscaping. For revegetation, the contractor will collaborate with the local forest office on the type of plants to plant in open areas.				
Land Use and Aesthetics Management						
Infrastructure rehabilitation works, Disturbance of sites, campsite construction	Changes in aesthetics, scenic view, visual character and land use	• The contractor will maintain consistency with existing land-use features and designs.	Construction Phase Monthly	• Minimised aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost 2000/month
Surface and Groundwater Pollution Management						
Activities and Works around and on water bodies	Poor water quality Public health and safety risks	• The contractor will control siltation, minimise unchanneled runoff and soil erosion by constructing drainage channels. • The contractor will provide sanitary facilities in the form of 2 VIP toilets for the workers at the campsite (1	Construction Phase Monthly Or as required in case of an	• Water quality results, monthly The monitoring parameters will include mostly physical and chemical drinking water quality	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		for females and 1 for males). These will be monitored and properly decommissioned by adding lime. • The contractor will inspect machinery and vehicles for spillages and leakages on a daily basis, before use. • The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the reservoir or water bodies will be prohibited. • The contractor will monitor water quality in the upstream basin and downstream by conducting initial water quality monitoring at commencement with monthly monitoring during construction.	emergency/ incident	parameters. Biological not included due to various limitations on the sampling protocols. These will be as follows; pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as No3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (ntu) and hydrocarbons (mg/l). The testing will be done at certified/ approved laboratories after proper sampling methods. • Pollution control structures • Training records, 100% of workers trained		

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
				• Inspections reports, weekly		
Air Quality and Noise Management						
Transportation, rehabilitation works at all worksites, campsite activities	Biomass burning impacts, dust from the roads and sites, noise from equipment	• The contractor will use auxiliary sites close to the dam to minimise haul distances and avoid worksites close to sensitive receptors such as households, clinics, schools etc. • Working hours to be limited to between 06:00 and 18:00. • The community will be sensitised on working sites and routes. Equipment noises below acceptable limits. • The contractor will continually water sites and limit soil movements during works by stone pitching sites or vegetation. However, care must be taken to ensure that water used for this activity does not deprive local communities or affect the dam water quantities	Construction Phase Daily	• Complaints records • Inspection sheets • Receptor sites protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month
Construction Materials (sand, stone, rock, gravel)						
Extraction and transportation activities	Land degradation, falls, waterborne diseases due to	• The contractor will source materials from reliable, regulated sources with ZEMA approved operations • The contractor will refer to the relevant management plans in the	Construction phase Daily	• Refer to the remedial design report • Use of approved regulated miners • Constant material	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 3000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
	collecting water, health and safety injuries during mining, non ZEMA regulated activities, soil erosion, biodiversity loss, traffic accidents, noise and air quality, child labour from unregulated sources	table; traffic, labour, air, noise, water, biodiversity, soil, land, health and safety. The contractor is also expected without fail to make reference to the Biodiversity Management Plan discussed in Appendix J.		supply • Environmentally mitigated operations and keep a copy of their environmental assessment • Refer to the relevant plans' performance indicators		
Campsite Management						
Construction, operation and decommissioning activities	Non-hazardous Waste management, Hazardous waste management, noise, wood fuel forest depletion, energy conservation, air pollution due to dust, water conservation,	• The contractor will refer to the relevant management plans in the table; air, noise, water, waste, biodiversity, soil, land, health and safety. • The Contractor will conserve resources –energy and water. He/she will collect and use what is required in a sustainable way. • The contractor will not use firewood/ forest for energy. • The contractor will not deprive the communities of their resources.	Construction phase Daily	• Refer to the relevant plans' performance indicators • Limited vegetation clearance • Campsite operations inspection reports • Well kempt campsite • Decommissioned site after operations as indicated in the decommissioning plan	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 4000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
	surface and ground water pollution, soil conservation, land pollution/ degradation, health and safety risks	• The contractor will not start wild fires or a fire in an undesignated area. Fire safety will be adhered to with extinguishers and assembly points on site.				
Traffic Management						
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• The contractor will assess available access, rehabilitate if needed and provide appropriate signage where relevant to inform the local community. If any road infrastructure is closed due to the works, alternative routes must be assessed and constructed with minimal impacts on the community social and environment aspects. • Contractor will prepare the traffic management method statement which will be reviewed and approved by UNOPS in collaboration with IDSP. The method statement will firm procedures and include cost. The management plan will cover parameters such as covering the transported raw materials with tarpaulin and avoid pollution of the environment or disturbance to the	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		local community. Additionally, once source of material is known, the contractor working in consultation with the engineer and the local authority will define a route to use throughout the construction period. • Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitisations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h). • In summary the contractor traffic management plan will include: the desired flow of pedestrian and vehicle movements, the expected frequency of interaction of vehicles and pedestrians, illustrations of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past, or through a work site or temporary hazard, and how short term, mobile work and traffic situations will be managed. • Responsibilities of people managing traffic in the workplace, responsibilities of people expected to interact with traffic in the workplace,				

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		and instructions or procedures for controlling traffic including in an emergency will also be included by the contractor.				
Biodiversity Management and Flow Management (to be clarified through a Biodiversity Assessment)						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	• The contractor will ensure the parameters contained in the BMP annexed to this ESMP are implemented during the construction period. • The contractor will ensure the communities are sensitised/trained and will avoid exploitation of biological resources. Contractor will review the content of the BMP regularly and update its workforce accordingly to ensure compliance. Specific method statement for works will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific construction practices which	Construction Phase Daily	• Number and extent of undisturbed areas • Species register • Flow measurement inclusion • Water quality results • Training registers and species protection regulations	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Fisheries Forestry	HSSE Officer Cost 2000/month UNOPS ecologist consultant costs

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where the method statement applies. • As guided in the BMP (Appendix J), the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity. • Making reference to the BMP the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered species, and protect nests. • The contractor will ensure protection of flows and reservoir water levels during rehabilitation works, allow for movement of aquatic species and sediments from the upstream to the downstream and avoid and minimise pollution of waters and quality degradation, minimising soil movements and sedimentation. This				

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		measure will be monitored through flow measurements and downstream water analysis on a quarterly basis. • The contractor will report all incidents to UNOPS and to authorities.				
Terrestrial Biodiversity **Works within habitats**	Biodiversity and habitat loss	• The contractor will ensure they implement the proposed measures as guided in the BMP annexed to this document.The contractor will ensure that all employees receive appropriate training in relation to biodiversity conservation as contained in the BMP. • As guided in the BMP, the contractor will avoid clearing unnecessary areas for works and disturbances to the habitat and ecology. Wherever possible the felling of significant/mature trees will be avoided and connectivity between areas of forest habitats will be maintained. • In the event that trees are cut to provide access to some infrastructure at the dam or when setting up a campsite, the contractor will record the number of trees cut for purposes of making a replacement at some point, in consultation with the	Construction Phase Daily	• Rehabilitation records and extents • Extents and number of disturbed sites and species • Training records and fauna register Vegetation cleared only in worksites	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 10000 UNOPS ecologist consultant costs

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		Department of Forestry • Consistent with the directive in the BMP, the contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organise alternative energy sources. • The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimise on destruction of terrestrial biodiversity. • Contractor will prepare site specific measures to enhance conservation of biodiversity site/ habitat. The specific method statement will include: o Location of the specific works; o Any details obtained in the pre-works services; o Explicit details of mitigation measures which should be applied in the area; o Details of any specific construction practices which should be applied in the area to protect biodiversity; o Details of any timing restrictions which apply to works in the area;		Number of trees cut and their details recorded for replacement (biomass equivalent) at rehabilitation phase		

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		○ Restoration details for the habitats within the area where the method statement applies. • The contractor will report all incidents to authorities and UNOPS				
Community Health and Safety						
Lack of safety measures **Dam use Crossings**	Community Health Risks which include accidents, injuries and drowning in open sites such as borrow pit	• The contractor will install safety signage around the dam reservoir, embankment, crossings, material sources, roads, depressions, pits and other sensitive sites. • The contractor will monitor traffic and road safety throughout the operations in order to maintain a safe working environment, including that workplaces, machinery, equipment and making sure processes under their control are safe and without risk to health. • The contractor will sensitise communities on safety and response, including sensitise communities on vector and waterborne diseases prevention and management. • The contractor will decommission stagnant water points, provide good quality drinking water, and practice hazardous waste management to promote health.	Construction Phase	• Adequacy of safety signage • Training records	Contractor Engineer and HSSE Officer UNOPS/ IDSP Ministry of Health	HSSE Officer Cost 15000

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		• Contractor will prepare the site emergency preparedness response plan which will be in a report and process flow format. This will include training, emergency personnel/ contacts, emergency numbers, hazards identified (chemical, biological, physical or natural disasters), risk levels, evacuation and routes mapping, response-emergency reporting and evacuation procedures, critical operations.				
	Contamination of water in the reservoir as a result of poor farming practises and open defaecation upstream	• The community living close to the dam, including those upstream shall be sensitised on the importance of having own latrine and avoid open defecation.		• Water quality free of coliforms. All parameters within the WHO limits	Ministry of Health & Ministry of Agriculture	
Occupational Health and Safety						
Poor occupational health for the workers	Injury to workers and Lost Time	The contractor will implement all reasonable precautions to protect the health and safety of workers. To ensure effective management of the works in this	Construction phase	• Training of workers, record in place • All workers in rightful PPE	Contractor Engineer and HSSE Officer	HSE Officer Costs

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		respect, Contractor is expected to have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements. Preventive and protective measures should be introduced according to the following order of priority: ● Eliminating the hazard by removing the activity from the work process. Examples include using an alternative that is less harmful, etc. ● Controlling the hazard at its source through use of engineering controls. Examples include machine guarding, acoustic insulating, etc; ● Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc. · ● Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.		Good house keeping		

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		• The application of prevention and control measures to occupational hazards should be based on comprehensive job General EHS Guidelines.				
Gender Equality and GBV						
Gender Mainstreaming	Work force does not have gender parity	• The contractor will endeavour to recruit 50% women among their locally recruited workforce.	Construction Phase	• Contractor recruitment plan includes 50% women	Contractor UNOPS	
GBV/SEA	Sexual Abuse, Exploitation (SEA) and Harassment of work force vis-à-vis the local communities	• The IDSP and UNOPS will conduct stakeholder consultations held with a focus on GBV/SEA and child protection risk • The contractor will ensure that all workers understand and sign a Code of Conduct (CoC) that reference zero tolerance in regards to GBV/SEA/SH. This also includes consultants and suppliers. • All CoCs will be disclosed through appropriate means (see SEP) – including in the local languages. • The contractor will ensure community and stakeholder awareness on GBV/SEA and child protection response mechanisms. • UNOPS to train senior GRM staff in GBV/SEA appropriate responses and referral mechanisms. Training of the	Construction Phase	• Reports on results of stakeholder consultations • Field monitoring missions are implemented at least once every month • All CoCs have been disclosed through appropriate means • Contractors has been provided with a standard CoC to use as a minimum • 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations • Community awareness sessions	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		GBV/SEA community focal point persons • The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if the survivor agrees, based on informed decision making. • UNOPS will monitor developments in the sub-project areas and conduct continuous assessments to understand trends in GBV/SEA/SH and child protection related issues		have been implemented at least once • 100% of senior GRM staff has received training session on GBV/SEA responses and referral mechanisms • Agreements have been reached with GBV service providers/ reporting entities		
	Sexual Abuse, Exploitation and Harassment at the workplace	• The contractor will ensure the application of a system to prevent SEA in the company • The contractor will ensure that all workers understand and sign CoCs, including consultants and suppliers. • The contractor will ensure all CoC are disclosed through appropriate means and will also be conveyed in the local language, for easy comprehension. • The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if	Construction Phase	• Field monitoring missions are implemented at least once every month • All CoCs have been disclosed through appropriate means • 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations	Contractor/UNOPS	Gender Consultant UNOPS, 16.000/year

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		the survivor has agreed based on informed consent.				
Labour and Working Conditions						
Labour and Working Conditions	General Risks and Impacts	• Contractors to recruit local workers where possible. • IDSP will establish and implement effective GRM (including address of GBV cases). • Adequate Occupational Health and Safety requirements. This will be in compliance with the local Factories Act and OSHA Act. This includes complying with the safe working conditions and safe acts on site. • The contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F) .	Construction Phase	• At least 60% of workforce at dam site is locally recruited • Contracts contain labour influx provisions • All workers have signed a Code of Conduct	Contractor UNOPS / IDSP	Included in GRM costs (not specific for labor influx UNOPS staff costs Contractor budget (awareness sessions in communities and for workers): 5.000 USD / 6 months
Labour Influx	Conflicts between local community members and workers based on cultural differences	• UNOPS/IDSP will conduct local community consultations during the sub-project design and implementation stage, as per SEP. • The contractor will disseminate rigorous information dissemination about sub-project details and GRM, as per SEP (see below). • This will include awareness raising among local communities and workers. • The Contractor will provide	Construction Phase	• Monthly reports received on consultations and key issues identified • Information on CoC has been translated in local language • 100% of workers from outside have received training	Contractor UNOPS	UNOPS staff costs / travel budget of Safeguards staff 20.000 USD / year Contractor budget (costs for awareness sessions / training 5.000 USD / 6 months

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		information on CoC (in local languages). • Contractor to conducts cultural sensitization of workers.				
	Increased risks of communicable disease, e.g. HIV/AIDS, STDs	• The contractor will implement awareness raising on HIV/AIDS and STD for the workforce.	Construction Phase	• Every workers has received training	Contractor UNOPS	Contractors' budget (training costs, awareness raising in community costs, translation costs for COC) 5.000 USD / 6 months
Conflicts	Conflicts between workers, based on cultural or other differences Risks of disagreements between local workers and employers	• The contractor will design and implement a workers' GRM. • The contractor will operate workers' GRM.	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget
Decommissioning and Rehabilitation Measures (Structured management to minimise environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the**	Residue impacts Aesthetic impacts Safety hazards	• The contractor will review of the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs 40,000

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
contractor's services and equipment used in performing the work required under the contract		• The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology, ecological effects, control measures for dam safety to prevent incidents, all items of plant and other materials, including buildings that may be decommissioned, rendered safe or removed from site for disposal or recovery in the event of demobilisation and closure. • The detailed rehabilitation plan will be in the contractor's site method statement.				
Disturbed work areas and Borrow pits	Soil erosion, aesthetics, drainage, safety hazards	• The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required. • The contractor will develop costed method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. • The contractor will rehabilitate areas disturbed during construction activities and during previous	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		construction activities. Disturbed areas will be restored as close as reasonably possible to pre-construction state and the soils will be restored to a condition consistent with other resource uses. Disturbed areas, slopes will be replanted with native plant seed mixes suited to the area. Topsoil that has been stripped and stored as part of the construction activities is to be levelled out as part of stabilization and rehabilitation activities. Correctly preserved topsoil provides viable sources of seeds stock, biological life and nutrient conditions that lead to vegetation establishment in addition to native species that will be purchased for full rehabilitation use. For every tree removed three will be planted. The rehabilitation plan will be in the contractor's site method statement. • Borrow pit rehabilitation – The Contractor will partially fill borrow areas with acceptable material (approved by the supervisor's ESS staff) to form a safe landform and covered with topsoil. Drainage should be ensured to avoid accidents and public health risks. The areas of				

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		disturbance and steep slopes must be stabilized. The rehabilitation plan will be in the contractor method statement and borrow management plan. • The contractor will implement rehabilitation and monitor effectiveness over three years.				
Access roads and paths used	Soil erosion, aesthetics, watershed restoration, safety hazards	• The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required. • The contractor will develop method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. • These roads accelerate erosion and contribute to siltation of the dam as well as water turbidity of the reservoir especially in the rainy season. The Contractor will repair of any existing roads used in accessing the dam site for decommissioning activities. Some of the unnecessary paths around the dam should be closed by ripping and planting of vegetation. Restoration of any over ground access areas through	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		replanting of native plant seed mixes suited to the area at three trees per one removed tree. Local/ native species are indicated in this ESMP. • Natural regeneration and adequate full area coverage assisted vegetation using native vegetation species will be implemented and monitored by the Contractor. • The contractor will ensure that the rehabilitation plan will be in the contractor's site method statement and management plan. • The contractor will implement rehabilitation and monitor effectiveness over three years.				
Campsite	Land use and aesthetics	• The contractor will remove all campsite facilities retaining those that need to be handed over to the community /DMC (if there will be any), for use. After accomplishing the dam construction works and before handing over, the campsite should be rehabilitated in an environmentally sound and acceptable manner to satisfy ZEMA regulations.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Contaminated materials and hazardous waste	Soil and water Pollution safety hazards	• The contractor will conduct detailed site inspections and prepare a snag list. Prepare snag list defining each area where remedial action is	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		necessary, including location of waste oil drums and/or other hazardous chemicals, location of oil-contaminated soils and the required actions. • The contractor will where possible return some materials to the suppliers, e.g. diesel and disinfectants for resale or reuse. The remaining materials be disposed of as waste, some of which may be deemed hazardous waste due to their composition e.g. oils. Such materials will be disposed of off-site in accordance with appropriate waste management regulatory requirements and facility waste management procedures. Soil contaminated with hydrocarbons will be excavated up to clean material beneath the base of the to the contamination plume and bio-remediated in a land farm. Where the contamination plume is shallow, in-situ bio-remediation will be conducted using nutrients and enzymes. Such sections will be mapped and backfilled with fresh soils. The rehabilitation plan will be in the Contractor's site method			Supervisor/ PIU	

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		statement.				
Pit Latrines	Pollution of groundwater and soil, safety hazards	• The contractor will decommission all VIP pit latrines that will be constructed by dismantling and the pits buried after applying lime. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Waste heaps and non hazardous waste	Landscape impacts, safety hazards	• The contractor will develop a snag list and conduct site inspections. • The contractor will ensure that rubble including vehicle and machinery parts and derelict components are removed from the site and transported for disposal at a ZEMA/ local authority certified dump site. All the heaps of soil will be levelled and areas that were used as workstations will be re-vegetated. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Stock piling	Land use and aesthetics safety hazards	• The contractor will ensure that all heaps of overburden material should be used to back-fill the borrow pits and the sections properly levelled to suit the natural landscape. • Stock-pilling/preservation of the felled trees - The recommended practice is that the contractor is	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		required to stockpile all the felled trees. There will be no burning of burying any felled trees.				
Reservoir Water Quality	Ecological services and aesthetic impacts	• The contractor will set up a designated livestock area on the upstream that will be stone pitched for controlled livestock movement and watering to prevent soil movements. • The ground will be prepared and then pitching will be done before vegetation is planted.	Construction Phase	• Livestock watering area at the basin	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Covid 19 Pandemic	Spread of Covid-19 pandemic among the workforce and the local community	• The contractor will provide and implement relevant COVID-19 guidelines for all the workers to follow in the quest to avoid/prevent the spread of Covid-19 among the workforce and the local community. This will be consistent with the provisions in the WHO and Zambia's Public Health Regulations on COVID-19 management.	Preparation and construction phases	• Sensitization and actual provision of sanitizers and face masks.	Contractor Engineer and HSSE Officer	**Included in rehabilitation cost**
				• Emergency preparedness and response plan for occupational emergency situations • Report on COVID-19 mitigation plan implementation		
Embankment fencing **Embankment structural works**	Forest cover loss threats Embankment failure	• The contractor will install metallic poles in a liner fashion for the animal barricade at the ends of the embankment wall to replace the temporary log fencing. • The contractor will completely dig out	Construction Phase	• Permanent fencing to keep animals away from the embankment	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		ant habitants and their tunnels exposed and broken down then backfill and compact with suitable fill material.				
Environmental Flow	Ecological flows	• The contractor will install the user friendly durable flow gauge for flow measurements during the periods when there will be flows (especially in rainy season) if the contractor will be carrying out rehabilitation works then. • UNOPS will conduct training for the DMC on flow reading and management. • A rock toe will be incorporated into the design of the downstream embankment drainage. A suitably sized rock toe should be considered to be incorporated into the remedial design. This should have a double filter layer along its intersection with the current downstream face at the toe to allow for safe drainage.	Construction Phase	• Training and flow monitoring	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Construction and Operation activities	Waste releases from local communities Public health and safety hazards Potential waste types include domestic solid waste due to activities around the dam- plastics, containers, boxes, papers	• The DMC will be trained on household waste management. There will be no disposal or storage of waste at the Chikowa dam site.	Operation Phase	• Properly designated waste collection and disposal points • Training/ sensitization records • Waste disposal records and logs • 100% of sites are cleaned up	DMC/ Water User Committee Ministry of Agriculture DWRD	500/month
Hazardous Waste Management						
Operation activities- pest management, fertilisers	Hazardous waste generation and releases into the environment- Chemicals	• IDSP, Ministry of Agriculture, Department of fisheries will train the communities on operation activities that minimise pollution of water. These are outlined in the capacity and training program.	Operation Phase Monthly	• Non-polluting farming, animal watering and fishing methods (e.g. farmers not to push nitrate-based fertilizers into the surface water/dam)	DMC/ Water User Committee Ministry of Agriculture DWRD	100/month

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
				are applied • Training/ sensitization records, 100% • Water quality monitoring records	IDSP	
Surface and Groundwater Pollution Management						
Livestock watering and activities in the water	Siltation Poor water quality	• The IDSP will conduct and promote community farming methods that will not pollute the water- chemicals or runoff and soil erosion. • The Department of Forestry, Community Development, Water Resources and IDSP will conduct catchment management sensitisations during community trainings to promote raw water quality in all catchment sources, review land use practices/ social needs, biodiversity conservation and minimise run off on a catchment scale. This will focus on creating a catchment management scheme. • Communities will continue sensitizing the farmers on catchment management practices, stock watering control and soil conservation.	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment • Pollution control structures • Training and sensitisation records	DMC Ministry of Agriculture Forestry IDSP	Once off- 20,000 700/month
Sanitation Management						
Community sanitation	Environmental pollution, public health risks	• The community will be trained in the impacts of open defecation.	Operation Phase	• Existing adequate sanitary facilities	DMCs Ministry of Health	500/month

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
	Breakout of water borne disease as a result of poor sanitation practices by communities living upstream of the dam	• Sensitization of the local community both those living upstream of the dam and those living around the dam, using a programme called Community Led Total Sanitation Programme (CLTS). This programme compels the members of the community to have atleast a toilet per household. This in turn reduces and completely stops open defecation by the same community members.	Construction and Operation Phase	• Records of sensitization programme stating where sensitization took place, how many of these programmes, name and number of villages attended.	During Construction IDSP working with Ministry of Health During Operations Ministry of Agriculture working closely with Ministry of Health	**7000**
Pedestrian Infrastructure Management						
Maintenance of access infrastructure	Deterioration of access infrastructure, increased chronic sediment delivery, disturbed hill slope hydrology, and impacts to aquatic, riparian, and terrestrial ecosystems of roads crossings	• IDSP will sensitise the community on appropriate use of the infrastructure to avoid and minimise failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. • IDSP will train DMC on use, maintenance and monitoring requirements.	Operation Phase Quarterly	• Training records • Inspection records • Maintenance records	DMC IDSP	3000/year

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
	Safety hazards					
Biodiversity Management and Flow Management						
Aquatic biodiversity, Construction and Operational activities	Biodiversity loss and ecological flow limitations, population increases	• The BMP will be implemented accordingly to ensure appropriate measures are put in place for biodiversity conservation purposes to the extent possible • Maintain ecological flows all year round and integrity of the ecological function • UNOPS to increase basin water holding capacity by rehabilitating the structure in order to enable constant downstream flows and basin water levels. Otherwise the basin may run dry. This would also relocate the aquatic species from the dam. A system for equitable allocation of water is based on available supply. • Include gauge levels monitoring facilities. DMC to strictly monitor inflows, retention water and outflows in order to have a balanced system. • UNOPS to include outlet infrastructure for downstream flows. • DMC to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. • DMC to monitor flow level changes downstream. Natural flows and dam controlled flows.	Operation Phase	• Ecological flows monitor • Relevant quantity, quality and timing of water flows required to sustain ecosystems and the human livelihoods and well-being that depend on these ecosystems in the downstream region	DMC Fisheries Forestry UNOPS IDSP	10000/year

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
		• Communities to protect vulnerable and endangered species. • Avoid exploiting biological use of resources and invasive methods. • Secondary developments to take aquatic biodiversity into consideration.				
Loss of fish in the dam, which is of conservation concern	Food insecurity	• MoA working with department of fisheries to train the community and DMC that benefit from the ecological value of the dam so they can learn sustainable fishing skills and preserve the fish juveniles in the shallow waters	Operations Phase	• Training records showing number of persons trained and when	Ministry of Agriculture; Department of fisheries	**6000**
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• Ensure protection of available terrestrial species in the project area to the extent possible, guided by the BDMP. • Active control of invasive and alien species after trainings by government departments. The community will incorporate catchment management measures habitats around the dam. Avoid displacements and over exploitation of species.	Operation Phase	• Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	1500/year
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	• IDSP to train DMC in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	• DMC exists • DMC has been trained	IDSP local authorities	5.000

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Community Health and Safety						
Catchment management	Excessive rates of erosion and sedimentation	• The IDSP will ensure the DMC and the officers from Government departments such as Water and Agriculture are appropriately oriented to appreciate the contents of the O&M Manual, use and benefits, for sustainable management of the dam catchment area.	Operation phase	• The following personnel trained in the implementation of the O&M; - DMC, - Waters Affairs - Agriculture - Camp site officer	IDSP DWRD DMC	Included in training costs above
Lack of safety measures **Dam use Crossings**	Public health risks and diseases Drowning Injury Dam failure	• The communities will be trained by IDSP and government departments in maintenance of safety signage around the dam reservoir, embankment, crossings, material sources, roads. • The contractor safety signage plan, location and type will be presented for approval to the supervisors and PIU by the contractor. Safety areas will include undesignated or risky crossing points or activities around the dam, community warning prior to opening any valves, flooding, health, safety, planning, prevention and response, reporting faults and security measures at the dam. • Budget allowing, the borrow pit sites can have protection fencing to deter children from slipping in.	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records	DMC Ministry of Agriculture DWRD IDSP	2000/year
Gender Equality and GBV Action						

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Gender Mainstreaming	DMCs do not have female members	• UNOPS will define gender parity in constitution of the DMC and include gender equality training in the training of DMCs.	Operation Phase	• DMCs have 50% female members	UNOPS	Included in training costs above
Maintenance and Monitoring Management						
Dam maintenance	Structural deterioration Dam Management	• The IDSP will conduct further DMC trainings on dam maintenance and dam safety. • The cam committee will ensure incidents are reported to the resident IDSP staff and are worked on. • UNOPS and IDSP will conduct Maintenance and Flow inspections trainings for communities and District Officers. • IDSP will conduct periodical Dam safety assessments. • IDSP will employ Record Keeping for the Dam maintenance works done by the department and by the community.	Operation Phase Bi annual	• DMC quarterly meetings and resolutions • Flow measurements and action plans • Training records • Dam maintenance records and monitoring records	UNOPS IDSP DWRD DMC	3000/ year
Monitoring measures	Lack of monitoring	• IDSP **will** conduct water quality measurements for parameters indicated in this ESMP. • IDSP **will** conduct and follow up on flow measurements • The Ministry of Fisheries and forestry **will** conduct biodiversity monitoring as indicated in the BAP.	Monthly	• Monitoring records • Pictures • Training records • Flow measurements • Water quality results, monthly The monitoring parameters **will** include biological, physical and chemical drinking water quality	UNOPS IDSP DWRD DMC	4000/ year

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
				parameters. These will include parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (ntu), hydrocarbons (mg/l) tests If hydrocarbon contamination is suspected, the test **will** be included. The testing **will** be done at certified/ approved laboratories after proper sampling methods		
waterborne diseases and	Poor community health and extinction of fish species	• Government to provide deliberate programmes aimed to educate the communities affected, with the best practises in regards to ensuring there are	Monthly	• Number of engagement programmes held on the topic	Ministry of Health and Ministry of fisheries	USD 10,000

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
fishing practices		no pads around their community and also to ensure good fishing practises are well inculcated in their minds.				

7.2 Rehabilitation Plan

This section discusses aspects requiring rehabilitation before the contractor demobilizes from the project area. The remediation plan is to a large extent covered in the actual remedial design works, and hence the discussion in this section is limited to aspects which are non-structural. This Rehabilitation Plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan', which provides guidance for rehabilitation specifications for embankments, borrow pits, access roads / tracks created during past construction/ and any areas of downstream erosion/embankment destabilization that has been caused by the previous construction works and the initial operation of the dam.

The main purpose of this plan is to identify and rehabilitate the existing aspects previously disturbed by dam construction works, which have caused environmental and safety issues. It is prepared with the objective to further outline requirements to ideally return previously disturbed sites to a state which is similar to its pristine condition. However, rehabilitation to pristine conditions may not be fully possible given that in most cases residue impacts remain at worksites. Therefore, rehabilitation with the aim to meet continuing or changing uses is foreseen. Rehabilitation will be part of the main project construction works and therefore will be costed and included in the BoQ.

The table below identifies aspects requiring rehabilitation by the contractor to ensure compliance with environmental safeguards which include demobilization of the contractor and the restoration of the Chikowa dam site.

In addition to the aspects identified specifically for rehabilitation by the contractor, effective monitoring tools are discussed below:

a) Environmental flow releases

There is need to designate a flow gauge reader to record flow results, to ensure continued monitoring and management of downstream ecological impacts.

b) Performance monitoring

There is need to undertake performance and impact monitoring of dam operations as a basis for adaptive management and to inform methods and tactics to manage long term impacts.

c) Downstream ecological flow

There is need to install gauge plates to measure water levels and water releases for purposes of developing data necessary for evaluation of downstream flow impacts.

d) Flooding of springs

During the remedial works, the IDSP, UNOPS and the contractor, should investigate the risk of flooding the springs when the dam embankment/spillway is heightened. This will inform various departments to prepare against loss of functionality and perennial water supply into the dam.

Table 12: Table showing non-structural aspects requiring rehabilitation at Chikowa Dam

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Structural risks						
Spillway	Location: Images: Section 5 'Dam characteristics' • Unstable drop structures, • Eroded Side of Spillway Outflow Channel, • Seepage in-between the masonry crest and the concrete structure of the spillway. • Top concrete erosion Risks: structure failure, and collapse of the footbridge	Yet to be proposed	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* _____ Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to ___ machine operators and ___ laborers as per above and up to __ months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	TBA	To be indicated in the BoQ
Embankment crest and slope stability risks	Cracks observed at the crest Risks: embankment stability	Yet to be proposed	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the	Contractor liability period Site inspections Pictures	Rehabilitated walls and adequate	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand, quantities ____ Rock, quantities _____ Crusher runner from a commercial quarry , quantities ____ Equipment Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to ___ machine operators and ___ laborers as per above and up to ___ months for the equipment	Continuous maintenance	gabion presence	
Training Wall	Eroded Risks: Weakening of side slope	TBA	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment*	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Rock, quantities _____ Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to ___ machine operators and ___ laborers as per above and up to ___ months for the equipment			
Non-structural risks						
Waste and rubble snag list	Not present on site					
Hazardous waste snag list	Not present on site					
Borrow pits	Location: three existing borrow areas though roughly covered in vegetation. These are about 1km west of the Chikowa Dam and measure around 20mx20m. Coordinates: Picked coordinate -13.4398°S ; 32.09409°E Images: Section 5.3.2	Include earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, and revegetation by seeding and natural succession vegetation, slopes and safety. Partially fill borrow areas with acceptable material to form a safe	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction Contractor Supervisor: UNOPS Remedial works will include earth ripping to enable regrowth of natural vegetation. Assisted vegetation (seeding and soil	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Contouring Drainage Stabilized slopes Desired landform	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	Risks: community health and safety, biodiversity loss	landform and covered with topsoil (there are some top soil vegetated heaps around the downstream borrow pit) or grading to a desired landform slope and drainage. Stock the existing vegetated sites' soils during borrow rehabilitation and place back when works are done. Plant native seeds in addition to the replacement of top soil to ensure coverage. Construct appropriate surface slopes with drainage channels to prevent water from collecting at the site. Final slopes within the site will be a maximum horizontal to vertical slope (H:V) of 3:1 or 33% grade. Ensure drainage to avoid accidents and public	fertilization with watering) will be included on all sites to supplement possible natural vegetation. The unnecessary roads should be close by scarifying the roadway, ripping and recontouring. Re-establish natural drainage patterns on the closed roads. *Materials and equipment* Earthworks Spoil Soils for top soiling within the borrow area stockpiles Grass seeds- approved noncompetitive native species Watering equipment Fertilizers/ soil fertility promoters Equipment Backactor; tractor dumpers; and haul truck *Workmanship and timeline:* up to 6 machine operators and 5 local workers for less than 4 months.			

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		health risks. Stabilize areas of disturbance and steep slopes. Implement reinstatement by natural succession together with full cover assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation				
Access routes	Location and Condition of the sites: 1 existing narrow gravel roads (about 1.5m wide) leading to the dam from the small road This is about 1km. Risks: biodiversity loss	Rehabilitate and close the roads, which will not be used by the current contractor Include earth ripping to enable possible regrowth of natural vegetation, even as	*Timing:* Day works- Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Ripped roads for revegetation Revegetation	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		assisted vegetation will be implemented on full coverage of the areas. Close unnecessary roads by scarifying the roadway, ripping and recontouring. Create an environment supporting over ground with natural regeneration to support the assisted vegetation. Assisted vegetation will included seeding, watering and maintenance of locally adapted vegetation. Re-establish natural drainage patterns on the closed roads	Limited gravel utilizing existing surface to form with a grader and tractor dumpers Grass seeds- approved noncompetitive local/ native species Watering equipment Fertilizers/ soil fertility promoters *Workmanship and timeline:* 4 Operators and 8 laborers as per above equipment 4 days per equipment			
Eroded and disturbed areas	Open areas around the basin, material area slopes, Risk: dam basin siltation, poor water quality contribution, limiting water use, soil movements and loosening	Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring and maintenance within	*Timing:* day works- Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment*	Contractor liability period Site inspections Pictures Continuous maintenance	Soil stabilization and livestock watering points	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation. Develop a costed method statement for disturbed sites Designate livestock watering points and promote soil stabilization by stone pitching, compacting and/ or trough creation as an alternative watering mechanism to keep some animals from the dam basin. The last option is the more expensive one of the two.	Earthworks Compacting, stone pitching material and native vegetation seeds for soil stabilization method Concrete trough, pump, tank Tractor dumpers; and haul truck for materials *Workmanship and timeline:* 10 laborers and 1 month use of the equipment			
Community health and Safety	Lack of safety signage around the dam Lack of safety and health sensitization over the dam	Include a method statement for the design of signage and location mapping. This will be approved by the supervisor.	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor	Contractor liability period Site inspections Pictures Continuous maintenance	Training records in all stipulated topics	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	Risk: accidents and waterborne diseases due to lack of knowledge and signage warning	Apply design-approved standard dam safety signage around the dam and contractor sites for construction and operational phases Finalize and administer the community sensitizations and training planned in the ESMP. These include drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc...	Supervisor: UNOPS *Materials and equipment* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 laborers	DMC regulation	Existing correct signage Signage method statement	
Flow gauges	Downstream flows	Flow monitoring	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period	Contractor liability period Site inspections Pictures Continuous maintenance and	Installed monitoring gauges Training records	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Implementation Role: Contractor, DMC Supervisor: UNOPS *Workmanship and timeline:* 1 operator and 4 laborers Equipment: concrete mixer and poker vibrator equipment	biodiversity monitoring		

Implementation Role: contractor, DMC
Supervisor: UNOPS

8. Capacity Building

Community / Stakeholder Health and Safety Training Plan

In compliance with the policy and legal framework, the environmental and social assessment recognized some training and knowledge gaps in relation to construction and operation phases of the Chikowa Dam. Capacity building will be the process used by which individuals and departments obtain, improve, and retain the skills, knowledge, tools, and other resources required for dam safety and environmental management at the dam. The training plan in the table below has been proposed for capacity building of district government staff, DMC members and community members in the vicinity of the dam. The implementation and execution of the sub-project will include additional training of relevant staff and communities, stationed in the various sites, during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health center, District department representatives, UNOPS E&S Team, UNOPS Dam safety Team, IDSP and the contractor.

In addition, the contractor will include in its work plans and carry out training of workers on the required safeguards measures they are expected to implement as part of the daily activities. The training material will be derived from the ESMP and the sub-project's Technical Dam Safety documents, and other sources. This section does not cover the contractor's training requirements, which are detailed in Appendix H.

Monitoring of the training will be conducted by the IDSP and UNOPS by reviewing the training materials, filing training records and noting feedback and following up on recommendations/ action plans.

The training topics include:
For District Officers;

- Policy and legal framework
- Dam safety management
- Maintenance and ESMP requirements/ roles
- Monitoring measures and procedures
- Stakeholder Engagement Plan
- Dam operation and roles

For Communities;

- Policy and legal framework
- Dam safety management including Emergency Preparedness and Response
- Community health and safety, including drinking water and water borne diseases, avoidance of dangerous spillway crossings, emergency preparedness in floods or dam failure, swimming and drowning risks, first aid in the event of potential drowning, risks of crossing at the dam spillways, management of livestock around the dam, malaria prevention and management, bilharzia prevention and management, management of other water borne diseases, use of dam water for drinking and emergency preparedness interactions with wild animals
- Grievance Redress Mechanism (GRM) and GBV
- Maintenance and ESMP requirements/ mitigation measures and monitoring.
- Dam operation and environmental flow
- Catchment management
- Biodiversity management and monitoring

The proposed training plan is shown in Table 19[19]:

Table 13: Training plan

Training content	**Number of days**	**Trainers/Supervision**	**Participants**
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: *Key training concepts: hazards, floods and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism* *Community health and safety:* *Key training concepts: pedestrian access infrastructure, construction safety, GBV, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, wild animals, malaria prevention and management, bilharzia prevention and management, water borne diseases, dam maintenance and ESMP monitoring* *First aid: First aid basics and response*	5 after ESMP disclosure prior to construction works Repeated after 3 months and at completion	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist Government: Local Health Post representative IDSP: Dam Safety Specialist Environmental and Social Specialists	100 community members 15 District DMMU members DMC
Estimated budget	USD 2,000 per session		
Grievance Redress Mechanism and ESMP monitoring requirements			
Key training concepts: sharing of the Environmental and Social Management Plan (ESMP) by IDSP/ Contractor to the stakeholders	2	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist	18 District Officers 2 officers from each of the following Departments: • Town Council

[19] UNOPS to have overview over planning and execution of training on behalf of the IDSP/P

Training content	Number of days	Trainers/Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
		IDSP: Dam Safety Specialist Environmental Specialist	• Ministry of Chiefs and Traditional Affaires • DWRD • Ministry of Health • Forestry Department • Ministry of Gender • Community Development • Ministry of Fisheries and Livestock • Ministry of Agriculture
Estimated Budget	USD 1,500		
Dam operation activities			
Key training concepts: fishing regulations, species, fisheries conservation, catchment management, environmental protection, forestry regulations and biodiversity conservation measures, dam sustainability, nurseries, farming methods and dams, sustainable irrigation, pest management, water pollution, crop selection, soil conservation methods	3 at works commencement and repeated annually	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Government: Agriculture Fisheries Forestry Community Development IDSP: Dam safety Specialist Environmental Specialist	100 community members
Estimated Budget	USD 1,000 per session		

9. Stakeholder Engagement

The Stakeholder Engagement Plan (SEP) seeks to define a structured, purposeful, and culturally appropriate approach to consultation and disclosure of information. UNOPS and IDSP recognise the diverse and varied interests and expectations of stakeholders and seek to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the sub-project. The aim is to create an atmosphere of understanding that actively involves project-affected people (PAPs) and other stakeholders leading to improved decision making.

Overall, this Plan defines the stakeholder engagement requirements in regards to:

a) engagement prior to remedial works about the immediate dam safety concerns;
b) engagement during (and related to remedial works dealing with construction impacts); and
c) engagement in regards to the long term use of the reservoir, maintenance of infrastructure, ensuring vulnerable groups benefit from the sub-project, community health and safety, etc.

While COVID-19 restrictions are still in place, strategies will be employed to include smaller meetings, small FGDs to be conducted as appropriate taking full precautions on staff and community safety. Where meetings are not permitted, traditional channels of communications such as radios and public announcements will be implemented.

9.1 Grievance Redress Mechanism

Stakeholder engagement includes access to a Grievance Redress Mechanism (GRM) implemented by IDSP. The GRM is designed ensure that feedback can be received in relation to the remedial works for the Chikowa Dam. It is set up to respond to concerns and grievances of all PAPs and to receive feedback related to the environmental and social performance of all activities.

Stakeholder engagement forms a fundamental element to ensure that the GRM process and relevant contact details are well communicated to the respective communities in the dam areas, and that communities are consulted on the performance of the GRM to allow for potential adjustments where needed. This Stakeholder Engagement Plan lays out how the GRM protocols are disseminated to all stakeholders.

DMC members thereby play a key role in the GRM, as they receive grievances or feedback from community members in person; hold the keys to suggestion boxes and regularly empty them; assess and clarify grievances; provide feedback to the community members; investigate grievances; provide appeals mechanisms for unsatisfied community members; document all grievances in a log/register; and report all grievances and their processes on a monthly basis to IDSP.

9.2 Stakeholder Participation

The preparation of the ESMP has relied significantly on local level stakeholder engagement to gain understanding of the needs of the dam communities, and potential risks and impacts as well as mitigation measures of the planned rehabilitation activities.

Stakeholder consultation was conducted through review of previous engagement notes from the WRDP reports, key informant interviews with government stakeholders, and focus group discussions and community consultations held during sub-project preparation. COVID-19 regulations were adhered to during engagement. The attendance sheets are shown in Appendix F.

It is important that affected communities and other stakeholders are given the opportunity to continually participate in the process during the remedial works. Therefore, consultations were held:

- To provide information about the previous and current sub-project and to get stakeholder information on key environmental and social baseline information at the sub-project site;
- To receive information on legacy site impacts of the previous project in relation to non-rehabilitated sites;
- To provide opportunities to stakeholders to discuss their opinions and concerns;
- To identify specific interests and to acme potential roles and responsibilities of stakeholders and ensure their approval and participation in the development of the ESMP; and
- To inform the process of developing appropriate management measures as well as institutional arrangements for effective implementation of the ESMP.

A summary of the views and concerns raised during the consultations and field visits to the Chikowa dam communities are stated below:

Table 14: Summary of the stakeholders meeting

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
1	Gravazio Zulu	The community felt the dam wall was weak and that very often its strength was compromised by the water flooding around the dam wall	Response: It is hoped that once the dam is rehabilitated.
2	Kamalizya Mwale	When asked why they could not put up gardens downstream of the dam, the community reported they were advised not garden near the dam. They reported they should leave at least 50m away from the dam, even though after that clearance, there was no garden downstream of the Chikowa Dam.	Response: The community was advised to attend agriculture training to be offered during rehabilitation works, to learn about some agricultural aspects important to protect the dam.
3	Albert Zulu	The community complained that the dam does not keep water due to its poor design and subsequently submitted that the dam may be deepened to increase its storage capacity. They observed that in the dam are	Response: The group was assured that the dam will be rehabilitated to take care of the concerns raised.

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
		trees and bushes which they feel should have firstly been removed before damming.	
4	Ida Nkoma	The spillway overtops and the erodes the banks across the spillway, which could be a health hazard.	Response: The team informed the group that once rehabilitated, the spillway will perform normally.
5	Rosemary Mwale	Reported that the dam wall was not adequately compacted, and that if the dam is not rehabilitated, it may collapse and become a heavier impact on their livelihood. She added that there was one submission about the house constructed for one affected persons, that this house was not well constructed as expected by the community.	Response: The team informed the meeting that rehabilitation of the dam was key. As regards the house which was not properly constructed, the complainant was requested to put this in writing or at least report the grievance formally to Ministry of Agriculture.
6	John Phiri	Reported a crack on the spillway .	Response: The crack has been noted and will be taken care of during rehabilitation.
7	Stelia Mwanza	The Area Councilor submitted that the measures to address dam weaknesses must be implemented as soon as is possible. The Councilor further informed the meeting that the previous contractor never appreciated the community in that the community members that worked for this contractor were not paid their dues for some months. The councilor pleaded with UNOPS to ensure the new contractor adheres to wage bill regulations and pays its workers accordingly.	Response: The institutions will be careful in selecting contractor, and this time there is an assurance that better contractor will take the day.
8	Christina Zulu	She reminded the meeting that the dam was not properly constructed and therefore looks forward to the rehabilitation works that will follow	Response: This was well noted and encouraged everyone to support the contractor and the

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
			engineer once works commence

Plate 22: Community Consultative Meeting in Picture (Observing COVID 19 Protocol)

9.3 Stakeholder Communication Plan

Information disclosure will rely on the following key methods: community meetings in coordination with local authorities (headmen, DMC, and district administration), community notice boards, phone communication (SMS), and radio broadcasts. At the national level information will be disclosed mainly by email and on the IDSP and UNOPS websites. Information will be disclosed in English, which is the official language of Zambia. Local authorities, such as the District Administrator, local headmen, the Chikowa DMC will be requested to inform communities in community meetings and through disclosure on social media where feasible.

Table 15: Stakeholder communication plan

Phase	Item to be disseminated	Actions	Responsibility	Registry Format
Information dissemination prior to remedial works about the immediate dam safety concerns	GRM	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
	ESMP	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc… – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders	UNOPS Social Safeguards Specialist and IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Information on dam safety concerns	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer	Minutes of meeting Messages produced for notice boards
	Information on construction	2 weeks before entrance of contractor – Meeting with local headmen, DMC members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer; Constructor	Minutes of meeting
Information Dissemination	ESMP	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g.	UNOPS Social Safeguards Specialist	Minutes of meeting Messages produced for notice boards

during remedial works		fisheries, agriculture, social welfare etc. – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders		Message sent to radio broadcaster Email message, website
	Any works-related information (on activities, details of construction activities, labor)	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer; Constructor	Minutes of meeting Messages produced for notice boards
	GRM	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
Information Dissemination in regard to the long-term use	GRM	Community meetings – with social distancing Community notice boards	Damc committee; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards
	Information on dam safety concerns	Community meetings – with social distancing Community notice boards	DMC; District Disaster Response Team; Local Headmen	Minutes of meeting Messages produced for notice boards

9.4 Stakeholder Consultation Plan

In addition to information dissemination, the sub-project will ensure consultations of PAPs in view of all sub-project activities, including environmental and social aspects. Consultations will mainly take place through community meetings. The GRM will be another means of consultation, as complaints received will be filed, assessed and responded to (see separate document).

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations prior to remedial works about the immediate dam safety concerns	Overall sub-project activities / E&S mitigation measures	Community meetings – with social distancing	Community level stakeholders, including vulnerable groups	UNOPS
		Meetings with women's groups of other vulnerable groups – with social distancing	Vulnerable community members	UNOPS
		Consultation meetings with local headmen, DMCs and district authorities	local headmen, DMCs and district authorities	UNOPS
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures	Community meetings (all interested community members)	Community level stakeholders	UNOPS
		Suggestion Box at district office, school, church	Community members, including vulnerable groups	IDSP Social Specialist

		Stakeholder meetings – with social distancing	DMC and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS
		Telephone hotline	All stakeholders, including vulnerable groups	IDSP Social Specialist
		DMC, local headmen, and District Disaster Committee to receive feedback in person	Community level stakeholders, including vulnerable groups	IDSP Social Specialist
		email	National level stakeholders	UNOPS

9.5 Proposed Strategy to incorporate the Views of Vulnerable Groups

UNOPS and IDSP will ensure that women, persons with disabilities, other members of vulnerable groups are participating effectively and meaningfully in consultative processes and that their voices are not ignored. This may require specific measures and assistance to afford opportunities for meetings with vulnerable groups in addition to general community consultations. For example, women may be more outspoken in women-only consultation meetings than in general community meetings. Similarly, separate meetings may be held with young people, persons with disabilities. Further, it is important to rely on other consultation methods as well, which do not require physical participation in meetings, such as social media, SMS, or radio broadcasting, to ensure that groups that cannot physically be present at meetings can participate.

In view of promoting gender equality, it is most important to engage women's groups on an ongoing basis throughout the lifetime of the sub-project. Women voicing their concerns and contributing in the decision-making process on issues such as community infrastructure should be encouraged, especially in various fora that predominantly consist of men.

GRMs are designed in such a way that all groups identified as vulnerable have access to the information and can submit their grievances and receive feedback as prescribed.

9.6 Reviews of Comments

IDSP will gather all comments and inputs originating from community meetings, suggestion boxes, GRM outcomes, and surveys. The information gathered will be submitted to the Social Specialist in the PIU, to ensure that the sub-project has general information on the perception of communities, and that it remains on target. It will be the responsibility of IDSP respectively to respond to comments and inputs, and to keep open a feedback line to the communities, as well as the local authorities. This SEP provides the overarching guidelines for the rolling out of stakeholder engagements.

10. ESMP Implementation Process

Step 1: Procurement and Bidding Process

Based on this ESMP and the remedial designs for the Chikowa Dam already developed, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Chikowa dam site. Specifications for environmental and social safeguards derived from the ESA and the ESMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as UNOPS Health & Safety requirements (see UNOPS Health & Safety Management Plan). The bidding documents will contain a general reference to the necessity to comply with this ESMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. These will include the required contractor's plans, COCs for workers, reference to workers' GRM the contractor will need to provide, compulsory workers and community trainings the contractor needs to implement. The bidding documents will contain requests for a detailed budget from the contractor for the implementation of all necessary actions to comply with this ESMP and specifically risk/impact mitigation measures laid out.

Step 2: Contractor Management

UNOPS will contract the contractor. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP. The Officer will be responsible for implementation and monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications.

The duties of the Officer will include but not be limited to the following: a) carry out health, safety, social and environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, pollution prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on health, safety, social and environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to health, safety, social and environment.

If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the social & environmental and health & safety requirements and submittals should be discussed, both for day-to-day work and for social and environmentally critical stages or activities.

- E&S/GBV Codes of Conduct are required of contractors and subcontractors and their workers (equivalent to sample in Appendix C);
- Contractors provide details on contractor's oversight on environmental, social, health and safety performance;
- Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns

of their workers;

- Contractor will prepare and affirm all plans and method statements required in this ESMP prior to construction activities
- Borrow pits and material sites
- Contractor emergency response plan
- Waste management
- Campsite activities
- Excavation works and stock piling
- Sanitation and water management
- Traffic management and access routes management
- Biodiversity management
- Signage design and plan
- Training, engagement and sensitization

- Contractor will work within the requirements of legislative requirements and standards
- Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact.
- Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS.

Step 3: Monitoring and Reporting Structures

UNOPS and IDSP will assign qualified and experienced environmental and social experts, as defined in the section on Institutional Arrangements. They will be responsible for routine supervising and monitoring all construction activities and for ensuring that contractor complies with the requirements of the contract.

- UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance.
- UNOPS will ensure regular supervision and monitoring of the implementation of all E&S mitigation measures laid out in this ESMP, as well as all trainings and other required activities.
- UNOPS will use the indicators all mitigation measures, as listed above in this ESMP, for its monitoring activities.
- A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the ESMP, confirmed the supervision of environmental and social specialist on site, photos records of works, camp areas, use of PPE, waste management, restoration efforts, grievances, accidents, communication, and training, among others.
- UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate.
- UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non-compliance situations will be dealt with in accordance with the set procedures in the contract.

The contractor must report on all HSSE matters related to this ESMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based

on its supervision and monitoring activities, as well as designated UNOPS activities in this ESMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local DMC and local authorities. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.

IDSP will implement its own monitoring and supervision activities as they apply for all AF activities, including the remediation of Chikowa Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.

Step 4: Incident Reporting

The contractor, UNOPS, and IDSP are required to report on any incidents related to the sub-project activities. The contractor will form the incident investigation team and will provide incident reporting on a monthly basis to UNOPS, and UNOPs will include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process in Figure 32:

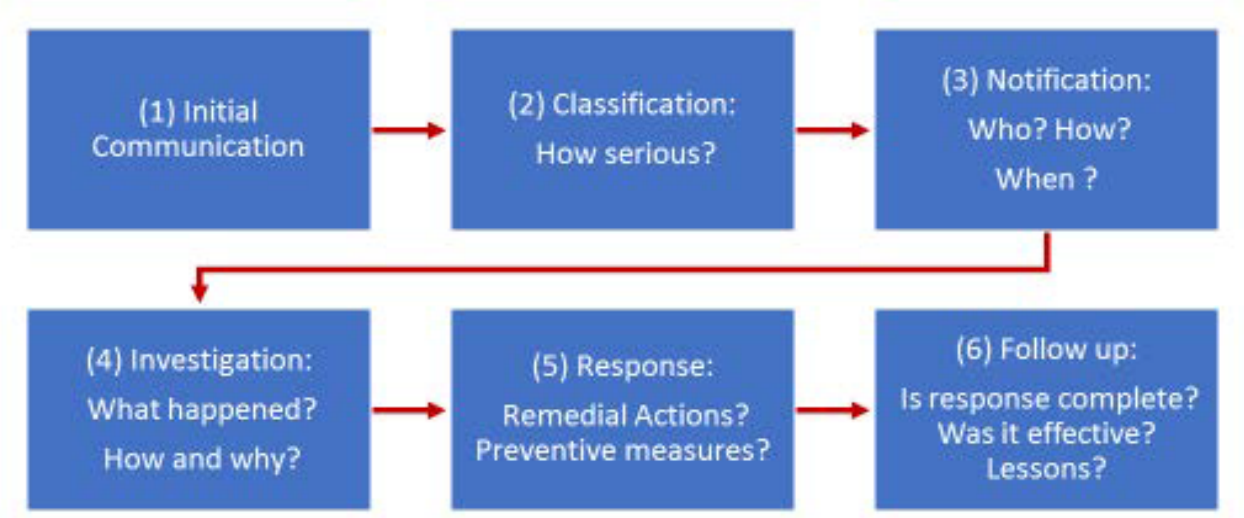


Plate 23: Incident reporting process

Incidents should be categorized into 'indicative', 'serious' and 'severe' (See Appendix G for World Bank classification of incidents).

- 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment.
- A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide).
- A 'severe' incident causes great harm to individuals, or the environment, or presents significant

reputational risks to the World Bank. Incident reports should use the format in Appendix G.

Severe incidents (an incident *that caused significant adverse effect on the environment, the affected communities, the public or workers*, e.g. fatality, GBV, forced or child labor) will be reported within 48 to UNOPS, IDSP and the World Bank.

Step 5: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Chikowa DMC who are part of the local community and local authorities.

Remedial actions that cannot be effectively carried out during construction must be carried out on completion of the works and before issuance of the acceptance of completion. UNOPS will be responsible for accepting the final works from the contractor and receiving approvals from IDSP. IDSP will manage the handover to the local entities and ensure that the dam communities have all capacities necessary to manage the dam. IDSP will be continually engaging with the communities and local authorities until the end of its lifespan.

References

An empirical economic assessment of impacts of climate change on agriculture in Zambia, World Bank, 2007

Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1

FAO, A Study of Fish Farmers in North-Western Province, Zambia, 1989, accessed at: http://www.fao.org/3/AD012E/AD012E04.htm

http://www.portergeo.com.au/tours/africa-b2001/africa-b2001litv1.asp; F. Mendelsohn (1961) and V.D. Fleischer 1976

Government of the Republic of Zambia, Irrigation Development Support Project, Environmental and Social Audit, April 2020

Ngonga, Z. Factors contributing to physical Gender Based Violence reported at Ndola Central Hospital, Ndola, Zambia: A case control study, In" Medical Journal of Zambia, Vol. 43.3., p. 145-151, 2016.

ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015

Tosun, Hassan, Earthquakes and Dams, May 20th 2015, accessed at: https://www.intechopen.com/books/earthquake-engineering-from-engineering-seismology-to-optimal-seismic-design-of-engineering-structures/earthquakes-and-dams

http://www.daily-mail.co.zm/Mambwe-district-agrarian-mineral-timber-rich-land/

Turyamurugyendo - Seismic Hazard Assessment in Eastern and Southern Africa, 1996

UNDP Climate Change Adaptation, Adaptation to the Effects of Drought and Climate Change, accessed at: https://www.adaptation-undp.org/projects/ldcf-drought-zambia

USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273

World Bank, Good Practice Note. Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, September 2018

World Bank, Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx, OPCS and ESSAT, December 2016.

World Bank, Water Resources and Environment. Technical Note D1, Water Quality Assessment and Protection, 2003, p. 32, accessed at: http://documents1.worldbank.org/curated/en/514141468768597679/pdf/multi0page.pdf.

World Bank, General Environmental Guidelines, Pollution Prevention and Abatement Handbook, p. 438; accessed at:
https://www.ifc.org/wps/wcm/connect/77a4c571-c743-48a8-9c6d-21d6ce77d017/genenv_PPAH.pdf?MOD=AJPERES&CVID=jqeDiLg.

World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at:
https://climateknowledgeportal.worldbank.org/country/zambia

Appendices

Appendix A: Completed Checklist

IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL RISKS RELATED TO THE REMEDIATION OF TEN - LEGACY DAM - IN ZAMBIA: Chikowa Dam

1-Date of the visit: 16th and 17th July 2020		
Name of the Environmental Specialist filling this checklist: Titus Chilongo		
Job Position: HSSE Analyst		
Have completed training in the Environmental and Social Safeguards of the World Bank: Yes / No…Yes		
Have read the Environmental and Social Audit report and the ISDS prepared for the Additional Financing of the project: Yes / No…a Yes		
Have you read the information available of this dam: Yes / No…Yes		
Note: if you marked No in any of these questions, you are not ready to fill this checklist. Please coordinate with the PIU team to provide you with these reports.		
2-Information about the Dam		
Name of the Dam: Chikowa Dam		
Location Mambwe District	**Region** Eastern Province	**District** Mambwe
Villages /communities	Kasalika	
Geographical location	**Coordinate South** 11° 8'11. 86"S	**Coordinate East** 28°56'22. 55"E
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Borrow Pit	Material sourcing	Access routes
Embarkment crest and slop	Erosion/ soil loosening	
Spillway drop structures	Site preparations/ clearing	

Other	Waste management	

4.MATERIALS NEEDED		
Does the project need aggregate or a new borrow pit	Yes	
Indicate potential sources to buy or extract the construction materials:	Within the Community	
Aggregates	Within the Community	
Sand/ clay	Within the Community	
Wood	Not Applicable	
Diesel for transportation	Mambwe Town	
Water source for the construction	Within the Community	
Water source for drinking for workers	Within the Community	

Contractors/builders		and Mambwe Town, possibly Chipata Town too
Estimated Number of workers to be hired for the construction works 15		**Who will pay in case of accidents or fatal accidents ……**The Contractor
Who will hire the workers	The Contractor	
Insurance provided to the workers	**Yes** □□ No □□Are contractors registered in Zambia in case compensations for accidents are needed	
		Contractors not yet engaged

5-General environmental conditions		
Is the dam is located within a protected area, KBA, or other sensitive location?	Yes □ **No** □□	Name of the protected area:
What are the conditions of the forest or natural vegetation in the project site	Explain: Disturbed by various anthropogenic activities	

6-Evaluation of impacts and mitigation measures to be included in the ESMP (you can use additional paper)	
Main environmental and social impacts: describe	**Possible mitigation measures**
Vegetation:	Re vegetation of open sites, access roads and around the Dam Preserve flora in the area.
Will the construction works needs to cut trees	**Yes** X No o
If the project needs to cut trees – the project will need to plant 3 trees per 1 tree cut	Indicate local native species and fruit species that the contractor will need to plant Location Number of trees Access route and material sourcing areas- 3 trees per cut tree Contractor will have to engage local forestry department to seek guidance on the type of trees to plant.
Water:	Maintain water quality during works and minimize further siltation in the basin Construct VIP toilet and safely decommission
Roads:	Rehabilitate roads after works Promote community health and safety
Safety	Erect safety signage, sensitize the communities, minimize public health threats
Hazardous waste	Storage in concrete bund without an outlet to the environment. Collection of any spillages Approved disposal method.
Other:	
7-LEGACY ISSUES /REMEDIATION	
PLEASE INDICATE. Any of these legacy issues that are environmental legacies that need to be resolved by the project, costed and included in the contract of contractors. Recommend measures so the engineering team can include them in the remediation plans.	
Legacies	**Measures to be included in the ESMP**
o **Solid waste (Wood, plastic, etc)**	To be managed in accordance with the instructions in the management plan
o **Hazardous wastes (diesel containers, old machinery, batteries, paints, metals, contaminated waters or soil,**	

o **Borrow pits**	Decommissioning and rehabilitation of three borrow pits
o **Unsafe paths**	Rehabilitation of roads used by contractor
o **Unfinished crossing points for communities**	Non
o **Other: Environmental flows and outlets**	Inclusion of outlets, flow monitoring gauges
8- Ecological Flow. Have you to coordinate with the technical team the options to improve ecological flows below the dam Yes No (you need to coordinate) Yes	
What is the flow below the dam (m^3/s)	To be confirmed-
Are wetlands below the dam No	**Are critical species present in the wetland or rivers: Not known yet. (indicate below species)** However, a full biodiversity assessment had been concluded, the reports and subsequent management plans done, and annexed to this ESMP
Are people using the water below the dam? What for?	It was reported that some of the community members access the water downstream for gardening, though this was not very evident.
Based on these findings, please indicate if it is possible to install a structural solution to improve the ecological flow **No** **Explain:**	**Yes Explain:** Though inlet flows upstream are low in the dry months **Structural measures** Outlets, gauges, spillway rehab **Operational measures** Flow measurements, training
9) Biodiversity. It is expected that you performed survey to the area or collect data with experts on diversity of the area for each dam. Please indicate what groups have been investigated in the project area and preliminary observations.	
Plants	Mammals
Fish	Amphibians
Macroinvertebrates	Other groups
Please indicate issues of poaching, illegal trade, and other issues affecting the area	

Presence of sensitive species:	
Critically Endangered species:	**Endangered species:**
Vulnerable species	**Migratory species:**
Protected species in Zambia:	**Endemic/rare/globally important species:**
Based on the results of the field observation, data collected and the OP 4.04 definitions	This project has natural habitat YES / NO The project area has critical habitats YES /NO
Based on the project area and the risk and potential impacts, you have identified for biodiversity –	

1-Please indicate the recommend measures to protect these species and Prepare in a separate document a Biodiversity Management Plan (BDMP) **2.In the area contains critical habitat and there is ecological flow needs please request to Prepare in a separate document as a Biodiversity and Ecological Management Plan (BDMP)**	
10-Final recommendation	
Name Titus Chilongo,	**Date: 27/08/2021**
Signature P.C	
Comments for the preparation of the ESMP and BDMP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys	
Field visits registration	

Appendix B: Chance Find Procedures

This procedure was developed to protect and preserve both tangible and intangible cultural heritage records of Zambia. This procedure is included as a standard provision in the implementation of sub-project public works contracts to ensure the protection of cultural heritage (archaeological and historical sites). All contractors as well as sub-contractors and implementers will be required to observe this procedure as documented hereafter.

Excavation in sites of known archaeological interest will not be allowed under this sub-project. Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied:

- Stop construction activities;
- Delineate the discovered site area;
- Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a full-time guard should be present until the responsible authority takes over;
- Notify the responsible foreman/archaeologist, who in turn should notify the responsible authorities (Ministry of Tourisms and Arts), the concerned governmental officers and local authorities (within less than 24 hours);
- Responsible authorities are in charge of protecting and preserving the site before deciding on the proper procedures to be carried out;
- An evaluation of the finding will be performed by the concerned officers from the Ministry of Tourism and Arts. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values;
- Decision on how to handle the finding will be reached based on the above assessment and could include changes in the sub-project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage;
- Implementation of the authority decision concerning the management of the finding;
- Construction work can resume only when permission is given from the Ministry of Tourism and Arts after the decision concerning the safeguard of the heritage is fully executed;
- In case of delay incurred in direct relation to archaeological findings not stipulated in the contract (and affecting the overall schedule of works), the contractor may apply for an extension of time. However, the contractor will not be entitled for any kind of compensation or claim other than what is directly related to the execution of the archaeological findings works and protections.

Appendix C: Sample Code of Conduct for Workers

United Nations Charter: The values enshrined in the United Nations (UN) Charter, *respect for fundamental human rights, social justice and human dignity, and respect for the equal rights of men and women*, serve as overarching values to which suppliers of goods and services to the UN1 are expected to adhere.

Global Compact: The Global Compact is a voluntary international corporate citizenship network initiated to support the participation of both the private sector and other social actors to advance responsible corporate citizenship and universal social and environmental principles to meet the challenges of globalization. The UN strongly encourages all suppliers to actively participate in the Global Compact. And to that end, this Code of Conduct has been developed with recognition of the importance of the ten principles of the UN Global Compact and is viewed as an important means of integrating the Compact into the operations of the UN. The Code of Conduct addresses the issues included in the Compact in the areas of human rights, labor, environment and anti-corruption and interpretation of the Code should be undertaken in a manner consistent with the Global Compact. Suppliers interested in supporting the Global Compact and obtaining more information on the ten principles, can visit the Global Compact website at www.unglobalcompact.org.

International Labor Conventions and Recommendations: The International Labor Standards (i.e., Conventions and Recommendations) as established by the tripartite UN specialized agency, the International Labor Organization (ILO), have served as the foundation on which much of this Code of Conduct is based. It is the UN´s expectation that any supplier providing products or services to the UN will, in addition to the values of the UN Charter, adhere to the principles concerning International Labor Standards summarized below in paragraphs 4 – 9.2

1. Scope of Application:
The UN expects that these principles apply to suppliers and their employees, parent, subsidiary or affiliate entities and subcontractors. The UN expects suppliers to ensure that this Code of Conduct is communicated to their employees, parent, subsidiary and affiliated entities as well as any subcontractors, and that it is done in the local language and in a manner that is understood by all. In order for a supplier to be registered as a UN supplier or to do business with the UN, the supplier is required to read and acknowledge that this Code of Conduct provides the minimum standards expected of UN Suppliers. In addition, suppliers should note that certain provisions of this Code of Conduct will be binding on the supplier in the event the supplier is awarded a contract by the UN pursuant to the terms and conditions of any such contract. Failure to comply with certain provisions may also preclude suppliers from being eligible for a contract award, as reflected in the solicitation documents of one or more organizations in the UN. Prospective suppliers are invited to review the specific terms and conditions of contract and procurement policies of the organization(s) within the UN with which they would like to do business in order to ascertain their current and future eligibility.

2. Continuous Improvement:
The provisions as set forth in this Code of Conduct provide the minimum standards expected of suppliers to the UN. The UN expects suppliers to strive to exceed both international and industry best practices. The UN also expects that its suppliers encourage and work with their own suppliers and subcontractors to ensure that they also strive to meet the principles of this Code of Conduct. The UN recognizes that reaching some of the standards established in this Code of Conduct is a dynamic rather than static process and encourages suppliers to continually improve their workplace conditions accordingly.

3.Management, Monitoring and Evaluation:
It is the expectation of the UN that its suppliers, at a minimum, have established clear goals toward meeting the standards set forth in this Code of Conduct. The UN expects that its suppliers will establish and maintain appropriate management systems related to the content of this Code of Conduct, and that they actively review, monitor and modify their management processes and business operations to ensure they align with the principles set forth in this Code of Conduct. Supplier participants in the Global Compact are strongly encouraged to operationalize its principles and to communicate their progress annually to stakeholders.
Labour:

4. Freedom of Association and Collective Bargaining: The UN expects its suppliers to recognize the freely-exercised right of workers, without distinction, to organize, further and defend their interests and to bargain collectively, as well as to protect those workers from any action or other form of discrimination related to the exercise of their right to organize, to carry out trade union activities and to bargain collectively.

5. Forced or Compulsory Labor: The UN expects its suppliers to prohibit forced or compulsory labor in all its forms.

6. Child Labor: The UN expects its suppliers not to employ: (a) children below 14 years of age or, if higher than that age, the minimum age of employment permitted by the law of the country or countries where the performance, in whole or in part, of a contract takes place, or the age of the end of compulsory schooling in that country or countries, whichever is higher; and (b) persons under the age of 18 for work that, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of such persons.

7. Discrimination: The UN expects its suppliers to ensure equality of opportunity and treatment in respect to employment and occupation without discrimination on grounds of race, colour, sex, religion, political opinion, national extraction or social origin and such other ground as may be recognized under the national law of the country or countries where the performance, in whole or in part, of a contract takes place. The UN expects its suppliers to take all appropriate measures to ensure that neither themselves nor their parent, subsidiary, affiliate entities or their subcontractors are engaged in any gender-based or other discriminatory employment practices, including those relating to recruitment, promotion, training, remuneration and benefits.

8. Wages, Working Hours and Other Conditions of Work: The UN expects its suppliers to ensure the payment of wages in legal tender, at regular intervals no longer than one month, in full and directly to the workers concerned. Suppliers should keep an appropriate record of such payments. Deductions from wages are permitted only under conditions and to the extent prescribed by the applicable law, regulations or collective agreement and suppliers should inform the workers concerned of such deductions at the time of each payment. The wages, hours of work and other conditions of work provided by suppliers should be not less favorable than the best conditions prevailing locally (e.g. collective agreements covering a substantial proportion of employers and workers / arbitration awards / applicable laws or regulations) for work of the same character performed in the trade or industry concerned in the area where work is carried out.

9. Health and Safety: The UN expects its suppliers to ensure, so far as is reasonably practicable, that: (a) the workplaces, machinery, equipment and processes under their control are safe and without risk to

health; (b) the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken; and (c) where necessary, adequate protective clothing and protective equipment are provided to prevent, so far as is reasonably practicable, risk of accidents or of adverse effects to health.

Human Rights:

10. Human Rights: The UN expects its suppliers to support and respect the protection of internationally proclaimed human rights and to ensure that they are not complicit in human rights abuses.

11. Harassment, Harsh or Inhumane Treatment: The UN expects its suppliers to create and maintain an environment that treats all employees with dignity and respect. The UN further expects that its suppliers, as well as their parent, subsidiary and affiliated entities along with any subcontractors, will neither use or engage in, nor allow their employees or other persons engaged by them to use or engage in, any: threats of violence, verbal or psychological harassment or abuse, and/or sexual exploitation and abuse. Sexual exploitation and abuse violate universally recognized international legal norms and standards and have always been unacceptable behavior and prohibited conduct for the UN. Prior to entering into agreements with the UN, suppliers are informed of the standards of conduct with respect to the prohibition of sexual exploitation and abuse, expected by the UN. Such standards include, but are not limited to, the prohibition of: (i) engaging in any sexual activity with any person under the age of 18, regardless of any laws of majority or consent, (ii) exchanging any money, employment, goods, services, or other things of value, for sex, and/or (iii) engaging in any sexual activity that is exploitive or degrading to any person. The UN expects its suppliers to take all appropriate measures to prohibit their employees or other persons engaged by the suppliers, from engaging in sexual exploitation and abuse. The UN also expects its suppliers to create and maintain an environment that prevents sexual exploitation and abuse. United Nations contracts will contain provisions concerning a supplier´s obligation to take appropriate measures to prevent sexual exploitation and abuse. The failure by a supplier to take preventive measures against sexual exploitation or abuse, to investigate allegations thereof, or to take corrective action when sexual exploitation or abuse has occurred, constitute grounds for termination of any agreement with the United Nations. Moreover, no harsh or inhumane treatment coercion or corporal punishment of any kind is tolerated, nor is there to be the threat of any such treatment.

12. Mines: The UN expects its suppliers not to engage in the sale or manufacture of anti-personnel mines or components utilized in the manufacture of anti-personnel mines.

Environment:

13. Environmental: The UN expects its suppliers to have an effective environmental policy and to comply with existing legislation and regulations regarding the protection of the environment. Suppliers should wherever possible support a precautionary approach to environmental matters, undertake initiatives to promote greater environmental responsibility and encourage the diffusion of environmentally friendly technologies implementing sound life-cycle practices.

14. Chemical and Hazardous Materials: Chemical and other materials posing a hazard if released into the environment are to be identified and managed to ensure their safe handling, movement, storage, recycling or reuse and disposal.

15. Wastewater and Solid Waste: Wastewater and solid waste generated from operations, industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to discharge or disposal**.**

16. Air Emissions: Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone

depleting chemicals and combustion by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge or disposal.

17. Minimize Waste, Maximize Recycling: Waste of all types, including water and energy, are to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.

Ethical conduct:

18. Corruption: The UN expects its suppliers to adhere to the highest standards of moral and ethical conduct, to respect local laws and not engage in any form of corrupt practices, including but not limited to extortion, fraud or bribery.

19. Conflict of Interest: UN suppliers are expected to disclose to the UN any situation that may appear as a conflict of interest, and disclose to the UN if any UN official or professional under contract with the UN may have an interest of any kind in the supplier's business or any kind of economic ties with the supplier.

20. Gifts and Hospitality: The UN will not accept any invitations to sporting or cultural events, offers of holidays or other recreational trips, transportation, or invitations to lunches or dinners. The UN expects its suppliers not to offer any benefit such as free goods or services, employment or sales opportunity to a UN staff member in order to facilitate the suppliers´ business with the UN.

21. Post-employment restrictions: Post-employment restrictions may apply to UN staff in service and former UN staff members who participated in the procurement process, if such persons had prior professional dealings with suppliers. UN suppliers are expected to refrain from offering employment to any such person for a period of one year following separation from service.

Appendix D: Managing COVID-19 Risks

UNOPS Guidelines for Construction Sites[20]

These requirements should be mandatory for UNOPS and all contractors, they should be issued in a formal, written instruction to the contractor using the template provided below.

Requirements: Construction sites should be treated like offices, with the following steps to be discussed with the Contractor and enforced by the UNOPS site supervisor.

General

1. Ensure that the people meeting the following criteria will not come to site:
    - any personnel showing symptoms of coughing, difficulty in breathing, fever, tiredness, aches and pains, nasal congestion, runny nose, sore throat or diarrhea, until a medical certificate is provided;
    - vulnerable persons (by virtue of their age, underlying health condition, clinical condition or are pregnant)
    - any person living with someone in self-isolation or a vulnerable person.
2. In the case that a worker is detected with COVID-19 the site will be closed and workers in contact with the individual will be required to self-isolate for 14 days until medical all-clear is granted.
3. Social distancing of at least 1 meter should be maintained at all times between personnel. Handshakes, hugs and other close contact interactions are therefore prohibited on site.
4. Hand washing station posted at the site entrance, with soap for all workers and people entering the site, and additional stations at locations in the site that make it possible for workers to frequently wash their hands. Hand sanitizers should be provided where hand washing facilities are unavailable to point.
5. A focal point to implement and monitor prevention measures should be designated.
6. No masks are needed on site for work unless hazardous materials are being used.
7. In case of any infringements, UNOPS will stop work of the contractor and delays that incur penalties will be the responsibility of the contractor.
8. UNOPS will refuse access to the site to any individuals seen breaking the hygiene protocols and may require the contractor to stop all works immediately.
9. UNOPS must cooperate with the Zambia country directives in response to the COVID-19 pandemic.
10. All cases should be reported to UNOPS as soon as detected, as well as to local health authorities.
11. These protocols are to be recorded as part of the HSSE requirements for the site.

Travel to sites

12. Wherever possible, workers should travel to site alone using their own transport.
13. Risk assessments should be used to determine the risks for local travel to sub-project sites and precautionary measures should be applied if these are deemed necessary.
14. Sites need to consider:
    - Parking arrangements for additional cars and bicycles

[20] This document was developed by field personnel and added to by construction personnel all over UNOPS. It should continue to be commented on by everyone, as we understand more about the virus and think of better ways to protect.

- Other means of transport to avoid public transport e.g. cycling
- How someone taken ill would get home.

Site Access Points

15. Focal point appointed by UNOPS or the contractor, with the site supervisor, will check the temperature and ensure hand washing prior to site entry of all personnel.
    - Focal point should have a thermometer to do so.
    - For larger sites, a nurse or medical staff may be provided, however, the goal is not to treat personnel who may have COVID-19, but identify any symptoms and ensure personnel are immediately removed from the site.
16. Focal point should ask the following questions to the staff:
    - Have you had a fever or other symptoms of the COVID-19 in the past 2 weeks?
    - Is there anyone in your household who has the symptoms or is ill with COVID-19?
    - Is there any person in your neighborhood or community who has been diagnosed with COVID-19?
    - Have you been abroad or in contact with travelers from different countries?
17. Ensure personnel wash or clean their hands before entering or leaving the site.
18. Stop all non-essential visitors.
19. Introduce staggered start and finish times to reduce congestion and contact at all time, if possible. Take into consideration appropriate timings for men and women, according to their other responsibilities. If there are fewer workers on sites ensure safety of female workers from sexual harassment (PSEA issues).
20. Monitor site access points to enable social distancing – site supervisor may need to change the number of access points, either increase to reduce congestion or decrease to enable monitoring.
21. Remove or disable entry systems that require skin contact e.g. fingerprint scanners
22. Reduce the number of people in attendance at site inductions and consider holding them outdoors wherever possible, also ensure 1 meter distance between participants during the inductions.
23. Drivers should remain in their vehicles if the load will allow it and must wash or sanitize their hands before unloading goods and materials.

Communication and awareness

24. Daily briefing on how to prevent exposure to COVID-19 and on the control measures in the site should be delivered.
25. Post posters about proper handwashing and respiratory hygiene at different sub-project sites (work fronts, temporary offices, and the sub-project operations campus)

Canteens and Eating Arrangements

26. Hand washing is enforced before mealtimes.
27. All personnel should be advised to observe safe distances during eating times.
28. All personnel should avoid sharing food and drinks with colleagues
29. The workforce should be asked to bring pre-prepared meals and refillable drinking bottles from home.
30. Site eating areas will be disinfected daily by the contractor.
31. All rubbish should be put straight in the bin and not left for someone else to clear up.
32. Where catering is provided on site, it should provide pre-prepared and wrapped food only. Where possible payment arrangements should be made such there will be no need to exchange money

e.g. contactless cards or pre-arranged monthly payments. Crockery, eating utensils, cups etc. should not be used.

Changing Facilities, Showers and Drying Rooms

33. Introduce staggered start and finish times to reduce congestion and contact at all times. Take into consideration appropriate timings for men and women, according to their other responsibilities.
34. Consider increasing the number or size of facilities available on site if possible.

Avoiding Close Working

There will be situations where it is not possible or safe for workers to distance themselves from each other by 1 meter. The following general principles should be applied:

35. Safety critical work should still be carried out with adequate personnel and under adequate levels of supervision to avoid incidents that may lead to loss of life.
36. Non-essential physical work that requires close contact between workers should not be carried out.
37. Work requiring skin to skin contact should not be carried out.
38. Plan all other work to minimize contact between workers.
39. Establish working groups to minimize the movement of people in the sub-project area to facilitate traceability and control, in case any possible contagion is identified.
40. Re-usable PPE should be thoroughly cleaned after use and not shared between workers. Ensure that female workers are given PPE purposefully designed for women.
41. Single use PPE should be disposed of so that it cannot be reused.
42. Stairs should be used in preference to lifts or hoists.
43. Increase ventilation in enclosed spaces.
44. Regularly clean the inside of vehicle cabs and between use by different operators.

Site Meetings

45. Only absolutely necessary meeting participants should attend.
46. Attendees should be 1 meter apart from each other.
47. Rooms should be well ventilated / windows opened to allow fresh air circulation.
48. Consider holding meetings in open areas where possible.

Cleaning

49. Enhanced cleaning procedures should be in place across the site, particularly in communal areas and at touch points including:
    - Taps and washing facilities
    - Toilet flush and seats
    - Door handles and push plates
    - Hand rails on staircases and corridors
    - Lift and hoist controls
    - Machinery and equipment controls
    - Food preparation and eating surfaces
    - Telephone equipment
    - Key boards, photocopiers and other office equipment
50. Rubbish collection and storage points should be increased and emptied regularly throughout and at the end of each day
51. Hired vehicle vendors should be informed to sanitize the interior of their vehicles daily. Drivers to be informed about the preventive measures as well.

52. Personnel using motorbikes should also sanitize the areas of the bike most touched.

Procedure in case of contagion

Any worker with symptoms of the COVID-19 should:

- Notify the supervisor that he/she is not fit to work
- Stay home for at least 14 days
- Maintain a minimum temperature control twice a day
- Report any person in his/her household of these symptoms and inform the supervisor
- Notify the doctor or health service if symptoms do not disappear or worsen.

Any personnel who is confirmed to be diagnosed with COVID-19 should report to the Health and Safety Advisor and the Manager on the site immediately. The reporting procedure should be in line with the EOI.CSG.2017.02 on Reporting and Management of Health & Safety and Social & Environmental incidents.

UNOPS Construction Site Supervision

Guidance: UNOPS personnel are expected to continue to work with contractors and other site personnel, unless there is a stop work order issued by the government. In the case that UNOPS personnel need to visit home in order to support family / relatives, this is understood and personnel may take leave. The sub-project will, if possible, seek additional UNOPS personnel to cover the gap in supervision, to ensure the quality of work continues to be maintained and that work site safety and COVID-19 procedures are followed.

Field Offices < 6 People and Field Monitoring

Requirements: In the general case that personnel are working and living in the same office, "work from home" is similar / same in terms of people as the office. In this case, personnel may continue to work in the office that they live in, however, "Reduced Contact Work" is advised. For field monitoring this involves:

- Ensure when visiting sub-project sites, physical distancing is maintained.
- Avoid consultations, meetings, gatherings which involve a large number of people, beyond the government advice, both for organizing and being a part of. For essential business requirements, limit the number of people (below 10) ensuring physical distance.
- Minimize travel which requires personnel traveling in a partner's vehicle or vice versa. Ensure adequate measures are taken.
- Any discussions with home owners or contractors are outdoors, at 1 meter distance.
- Offices maintain the same protocols with washing hands prior to entry.

In case travel restrictions involve being restricted from any movement at all, personnel will be encouraged to work from home.

Short monitoring/handover missions (for multiple sites)

- Create clusters of 10/15 sites to visit. Sites should be geographically close and visitable in a one (long) day mission.
- Prepare maps of those clusters of sites, including travel distances.
- Prepare mission timetables with detailed timing for each activity (visit of site A, movement, visit of site B, etc.).
- Ask the contractor to submit pictures and videos of sites ready for handover in a pre-handover evidence folder of the teamdrive shared with the contractor.
- Review submissions in detail and pre-clear the sites ready for handover.
- Coordinate with the client and make precise appointments for handover activities, update the mission timetable according to availability of client's representatives.

- Arrange cars for standalone trips of our Site Supervisors (cars should be provided with water tanks, soap, sanitizer, PPE, lunchboxes, etc.).
- Brief and debrief our Site Supervisors prior/after each handover mission.

For HSSE specific guidance and support, please see the following UNOPS intranet links, or write to hse@unops.org:
https://intra.unops.org/operations/oversight/risk-management/hsse
https://intra.unops.org/news/announcements/update-on-the-coronavirus-covid-19-outbreak
https://intra.unops.org/operations/oversight/risk-management/hsse/covid19-response-update

IRRIGATION DEVELOPMENT SUPPORT PROJECT (IDSP)

COVID-19 Response Planning and Monitoring

August 21, 2020

Project Name, P#, and contract #	Contract/ activity	Impact of Corona virus on operation	Action identified	Responsible for Action	Anticipated Impact Colour Coding levels of Risk: High = RED; Substantial = Orange; Moderate = Yellow and Low = Green Likelihood: Highly Likely=HL; Extremely likely=EL; Not likely=NL Timing: Short-term=ST; Mid-Term; Long-Term=LT			
					Description	Level (H, S, M, L)	Likelihood HL/ EL /NL	Timing (ST/ MT/LG)
IDSP								

Appendix E: Template for Conditions of Contract

DIRECTION TO IMPLEMENT HEALTH AND SAFETY MEASURES - COVID 19 EPIDEMIC

Dear Sir
[*insert name of contract*] ("Contract")
This is a Notice served under Sub-Clause xxx of the Contract.
Taking into account the circumstances arising out of the Covid-19 pandemic, the Employer's Representative, hereby, instructs you to implement the Health and Safety measures that are listed in appendix 1 of this notice.
These measures are deemed to be reasonable precautions to maintain the health and safety of the Contractor's Personnel and as such are not additional to your existing obligations under the Contract and will not be considered as a Variation.
The Employer's Representative also reminds the Contractor of its obligations under Sub-Clause 6.16 which states that:

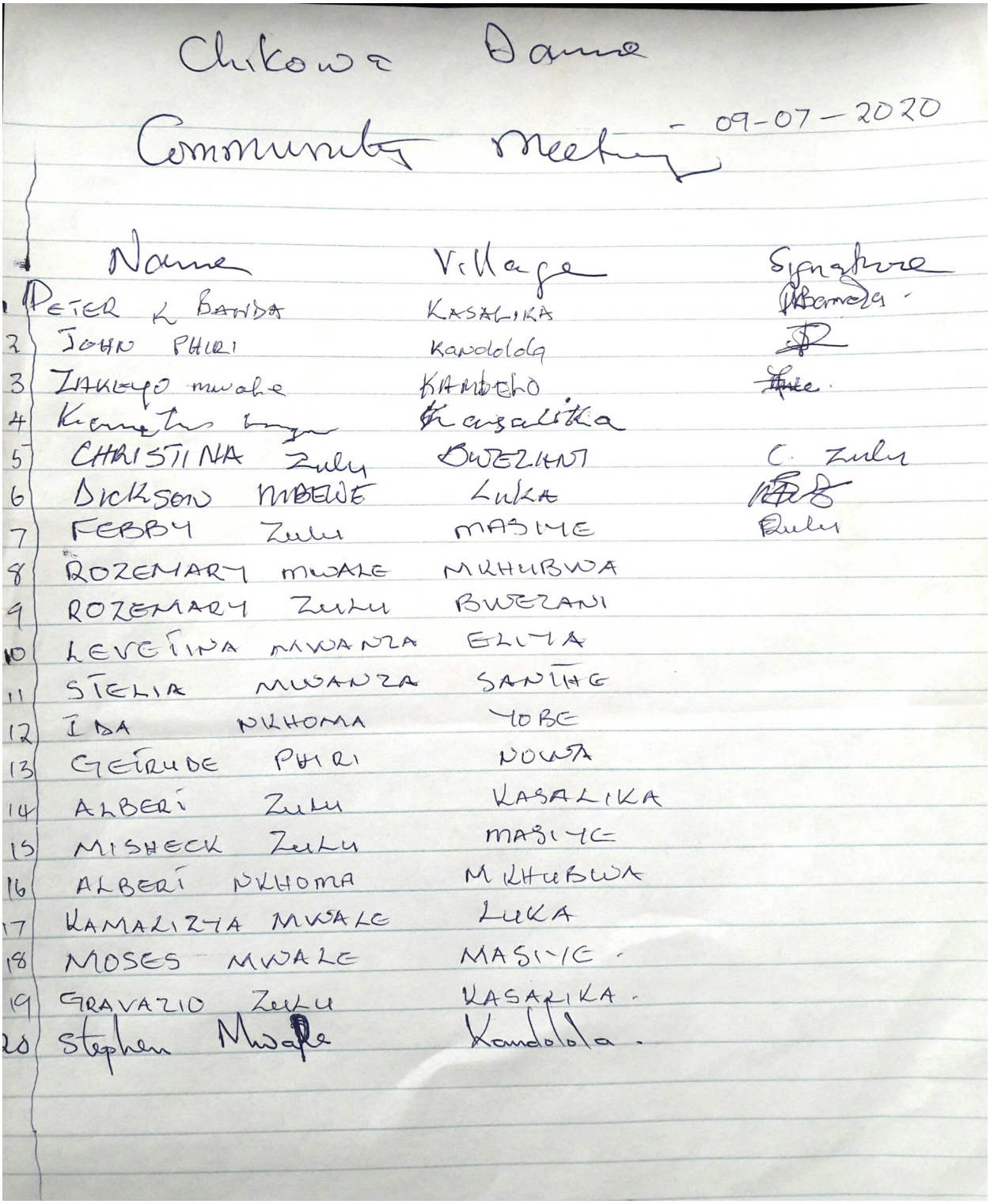
> *In the event of any outbreak of illness of an epidemic nature, the Contractor will comply with and carry out such regulations, orders and requirements as may be made by the Authorities or local medical or sanitary authorities for the purpose of dealing with or overcoming the epidemic.*

The Contractor is required to submit evidence of its compliance with the above health and safety measures by [*insert date*].

Yours faithfully

……
[*Employer's Representative*]
for and on behalf of UNOPS

Appendix F: Attendance Sheet – Stakeholders & Community Consultations



Chikowa Dam

Community Meeting - 09-07-2020

	Name	Village	Signature
1	PETER K BANDA	KASALIKA	
2	JOHN PHIRI	Kandolola	
3	ZAKEYO mwale	KAMBEHO	
4	Kenneth [illegible]	Kasalika	
5	CHRISTINA Zulu	BWEZANI	C. Zulu
6	DICKSON MBEWE	LUKA	
7	FEBBY Zulu	MASIME	Zulu
8	ROZEMARY MWALE	MKHUBWA	
9	ROZEMARY Zulu	BWEZANI	
10	LEVEFINA MWANZA	ELIMA	
11	STELIA MWANZA	SANTHE	
12	IDA NKHOMA	YOBE	
13	GERTRUDE PHIRI	NOWA	
14	ALBERT Zulu	KASALIKA	
15	MISHECK Zulu	MASIME	
16	ALBERT NKHOMA	MKHUBWA	
17	KAMALIZYA MWALE	LUKA	
18	MOSES MWALE	MASIME	
19	GRAVAZIO Zulu	KASALIKA	
20	Stephen Mwale	Kandolola	

Appendix G: Chikowa DMC

CHIKOWA DAM COMMITTEE REGISTER

NAME	NRC	POSITION
PETER BANDA	208316/52/1	CHAIRMAN
ZAKEYO MWALE	204394/61/1	VICE CHAIRMAN
VICKSON MWALE		SECRETARY
JOHN PHIRI	472643/52/1	VICE SECRETARY
GETRUDE PHIRI	372768/52/1	TREASURE
EXAVIEL SAKALA	473138/52/1	COMMITTEE MEMBER
CHRISTINA ZULU	441931/52/1	COMMITTEE MEMBER
ELIZABETH MWALE	107590/58/1	COMMITTEE MEMBER
MARY MWANZA	107083/58/1	COMMITTEE MEMBER
BELDER NKHOMA		COMMITTEE MEMBER

Appendix H: World Bank Incident Classification Guide and Incident Report Form

Indicative

- Relatively minor and small-scale localized incident that negatively impacts a samll geographical areas or small number of people
- Does not result in significant or irreparable harm
- Failure to implement agreed E&S measures with limited immediate impacts

Serious

- An incident that caused or may potentially cause significant harm to the environment, workers, communities, or natural or cultural resources
- Failure to implement E&S measures with significant impacts or repeated non-compliance with E&S policies incidents
- Failure to remedy Indicative non-compliance that may potentially cause significant impacts
- Is complex and/or costly to reverse
- May result in some level of lasting damage or injury
- Requires an urgent response
- Could pose a significant reputational risk for the Bank.

Severe

- Any fatality
- Incidents that caused or may cause great harm to to the environment, workers, communities, or natural or cultural resources
- Failure to remedy serious non-compliance that may potentially cause significant impacts that cannot be reversed
- Failure to remedy Serious non-compliance that may potentially cause severe impactsIs complex and/or costly to reverse
- May result in high levels of lasting damage or injury
- Requires an urgent and immediate response
- Poses a significant reputational risk to the Bank.

An incident report should contain the following information:

Incident Report Form

Please report any incident within 24 hours to UNOPS:

Contractor	
Dam Site	
Report Date	
Reported By (Name and Title)	

i. Details of Incident

Incident Date	
Incident Time	
Incident Place	

ii. Identification of Type of Incident and Immediate Cause

1. Select the type of the incident from the list below. An incident can be classified at the same time as health&safety/environmental/social.

Type of Incident: (and incident can cover more than one type):

Type of Incident – Health & Safety		Type of Incident – Social	Type of Incident - Environmental
Moving Machinery/vehicles at project site	Dust, Fumes, Vapours that impact the population and/or environment	Misuse of UNOPS property	Chemical/Oil Spill with impact on population and/or environment
Powered Hand tools	Noise	Damage to Cultural Heritage	Improper Disposal Waste
Hand Tools	Temperature or heat	Occurrence of infringement of labor rights	Disasters (Earthquake, Flood, etc)
Animals or insects	Overexertion	Occurrence of infringement of human rights	Water Pollution/ Sedimentation
Fire or Explosion at sub-project site	Structural Failure	Strike, demonstration	Damage to ecosystems (e.g. damage to flora/fauna)
Trips & smaller falls	Chemical/biological	Other (please specify)	Odor air Emissions
Drowning	Stress	GBV/SEA or Child Risks	Dust, Fumes, Vapors, Air pollution with impact on population and/or environment
Borrow-pit Management	Other (please specify)		Other (please specify)

2. For each type of incident, select the relevant descriptor(s) from the list. You can select up to 5 descriptors for each type of incident. If a descriptor is not listed below, please type in short descriptor in "Other". Add more rows as necessary.

Incident Type	Descriptor 1	Descriptor 2	Descriptor 3	Descriptor 4	Descriptor 5	Other
Health & Safety						
Social						
Environmental						

Provide a description of the immediate cause of the incident:

iii. Description of the Incident

Record all facts prior to and including the incident, if it was a planned activity, describe/list material, ecosystem and property damaged, etc:

iv. Root Cause Analysis

Select the root cause(s) of the incident from the list below. If 'Other', please specify:

Root Cause	Yes	No
Improper Planning		
Poor Maintenance		
Poor Supervision		
Poor Quality of Equipment		
No rules, standards, or procedures		
Lack of knowledge or skills		
Improper motivation or attitude		
Failure to comply with rules		
Other		

Additional Questions:
- Is the incident still ongoing or is it contained?
- Is loss of life or severe harm involved?
- What measures have been or are being implemented by the Implementer?

Appendix I: Summary of Construction Contractor Training Requirements

Training content	Number of days	Trainers/Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: hazards, and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism *Community health and safety: safety talks, pedestrian access infrastructure, Construction safety, GBV, waste management, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, malaria prevention and management, pollution prevention, bilharzia prevention and management and water borne diseases* *First aid: First aid basics and response*	Throughout	Construction Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members Contractor's first aiders
Grievance Redress Mechanism and ESMP requirements			
Sharing of the Environmental and Social Management Plan (ESMP) by Contractor to site accessing persons *Environmental management plans* *Grievance redress mechanism*	Throughout	Construction Contractor Supervision UNOPS: Environmental Specialist Environmental health and safety Specialist Dam Safety Specialist IDSP: Dam safety Specialist Environmental Specialist	All staff Community members

Appendix J: Biodiversity Assessment and Management Plan

EXECUTIVE SUMMARY

Biodiversity Assessment Results

Three types of habitats were identified within the Chikowa Dam area of influence. These were: miombo Woodlands; riverine or riparian and dambos or shallow wetlands. Miombo Woodlands, which is by far the most extensive type of habitat on site has sporadic specialized habitats such as Hill Miombo and Termitaria habitats.

A total of 22 terrestrial tree species were observed in the sampled area (18,840m^2) within the Chikowa Dam area of influence. In this area, a total of 713 stems were recorded. *Julbernadia Paniculata* had the highest number of stems with 169 followed by *Diospyros kirki* and *Diplorhyncas condilocarpon* both with 60 stems and *Combretum zeheri* with 46 stems.

The assessment established that *Julbernadia Paniculata* had the highest IV (93.60%) followed by *Diospyros kirki* (54.93%), *Diplorhyncas condilocarpon* (54.92%) and *Combretum zeheri* with 53.02%. The four species with the least IV were: *Pseudolachynostalis maproneifolia* (7.36%), *Pterocarpus angolensis* (7.77%), *Kirkia acuminate* (8.22%) and *Acacia conilum* (14.89%). Based on the analysis results, the conclusion is that the most dominant, common or abundant flora species within the sub project area of influence are *Julbernadia Paniculata*, *Diospyros kirki*, *Diplorhyncas condilocarpon* and *Combretum zeheri*.

All of the recorded terrestrial flora species in the project area of influence are listed as Least Concern under the IUCN Red List.

Regarding terrestrial mammals, a total number of 28 species were recorded with the most commonly observed being: Scrub Hare, *Lepus saxatilis*; Bush Squirrel, *Xerus inauris*; Field Mouse, *Apodemus sylvaticus*; Dwarf Mongoose, *Helogale parvula*; and African Civet, *Civettictis civetta*. None of the species recorded have a conservation status of concern per the IUCN Red List.

Twenty six (26) reptile species were recorded. Among these the most common or main ones were: Common Rough-Scaled Lizard, *Meroles squamulosus*; Striped Skink, *Trachylepsis striata*; Bushveld Lizard, *Heliobolus lugubris*; Southern Rock Agama, *Agama atra*; Common File Snake, *Gonionotophis capensis*; African Rock Python, *Python sebae*; African Puff-adder, *Bitis arietans*; Twig or Vine Snake, *Thelotornis capensis*; Olive Grass Snake, *Psammophis mossambicus*; Monitor Lizard, *Varanus exanthematicus*; and Marsh Terrapin, *Pelomedusa subrufa.* None of the species recorded have a conservation status of concern per the IUCN Red List.

The Chikowa dam project area of influence is rich in avifauna with 95 bird species recorded within the project area of influence. The high number of bird species is attributed to the availability of water in the dam and a well forested area on the immediate South East of the dam. None of the species recorded have a conservation status of concern per the IUCN Red List.

Eleven (11) amphibian species were observed within the subproject area of influence. These were primarily frogs and toads. Of these, the most common or wide spread was the Grey Foam-Nest Tree Frog, *Chiromantis xerampelina* and the Plain Grass Frog, *Ptychadena anchieta.* None of the species recorded have a conservation status of concern per the IUCN Red List.

In terms of invertebrates, a total number of 52 species were identified during the survey. Of these, grasshoppers were the most abundant accounting for 13 species followed by crickets with 7 species. None of the species recorded have a conservation status of concern per the IUCN Red List.

Water analysis results show very small quantities of ammonia, nitrates and phosphates across all sampled points except at the dam wall, where ammonia and phosphates appear at heightened levels. Suffice to mention that these are major constituents of fertilizers used in Zambia. Since no agricultural activities are visible within the vicinity of the dam, the high levels of ammonia and phosphate could be attributed to natural sources, viz-a-viz breakdown of organic matter and natural decomposition of rocks/minerals respectively by the dam wall. These chemicals in the long term have potential to trigger an algae bloom which could be detrimental to the ecosystem.

In the water samples analyzed by the Department of Fisheries, 9 phytoplanktons and 18 zooplanktons were identified. Both are important as regards maintaining a stable trophic status. Moreover, they are important biological indicators of water quality of aquatic ecosystem as they respond quickly to the environmental changes.

A total of 9 phytoplanktons and 18 zooplanktons were identified at Chikowa. These planktons are key components of the trophic status. A number of water quality parameters (temperature, Ph, transparency, dissolved oxygen) investigated in-situ, generally registered readings within the normal ranges, though some diversions from the normal range were noted. Chemical analysis of water samples done in the laboratory at the University of Zambia, showed heightened levels of ammonia and phosphates levels by the dam wall. Since no agricultural activities are visible within the vicinity of the dam, the high levels of ammonia and phosphate could be attributed to natural sources, viz-a-viz breakdown of organic matter and natural decomposition of rocks/minerals respectively by the dam wall. These chemicals in the long term have potential to trigger an algae bloom which could be detrimental to the ecosystem.

As regards fish species, 12 were identified: Blunttooth catfish (*Clarias ngamensis*) LC, Sharptooth catfish (*Clarias gariepinus*) LC, Bulldog (*Marcusenius macrolepidotus*) LC, Redbreast tilapia (*Coptodon rendalli*) LC, *Redeye Labeo (Labeo cylindricus) ,* Cross (Oreochromis machrochir & Oreochromis andersonii), *Barbus* sp, LC Synodontis *sp*. LC, *Nkupe (Distichodus mossambicus)* DD, Butter catfish (*Schilbe intermedius*) LC, Three spotted tilapia (*Oreochromis andersonii*) VU, Greenheaded Tilapia (*Oreochromis machrochir*) VU. All the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Nine invertebrates were encountered: Dragon flies *(Anisoptera sp*.) DD, Horse fly (*Tabanus bovinus*) DD, Mosquito (*Aedes sp*) DD, Whirligig beetles *(Gyrinus natator*) DD, water boatman *(Corixidae sp*.) DD, water strider (*Gerridae sp*)DD, Mayfly (*Baetidae*) DD, Crab (*Potamonautidae sp*) DD, Snails (*Gastropoda sp*) DD.

Aquatic plants encountered were 8: Bullrush (Typha angustifolia), Water primrose (*Ludwigia peploides*) LC, *Tena tena* (local name), Reeds(Phragmites sp.) LC, Smartweed (*Polygonum pensylvanicum*) LC, African star grass, Cattail (Typha latifolia) LC, *Nembaule* (Local name). These are important with respect to providing shelter, food and breeding site to some fauna entities.

Predicted Project Impacts

The project impacts on flora and fauna are mainly due to clearing activities for access roads, workers' camp, parking and working areas for equipment. These and associated activities may result in the following potential impacts:

- Loss of indigenous vegetation on site;
- Loss of fauna habitats and consequently loss of fauna;
- Habitat fragmentation;
- Injury or mortality of fauna resulting from collision with vehicles, equipment on site; increased noise levels and likely hunting activities;
- Introduction of invasive species and pathogens as a result of movement of people and equipment into and out of the project site; and
- Possible loss of aquatic fauna and flora as a result of water contamination.

These impacts constitute relatively minor risks that can be managed by well-known and proven construction impact methodologies. Overall, the rehabilitation of unremediated areas from the previous construction is expected to stabilize the environment around the dam wall and other areas of project disturbance, resulting in a reduction in erosion and sedimentation into the dam and the local drainage line. Provision is made for the management of these risks in the project ESMP and in this BMP.

Subject to the recommended mitigation, the continued operation of the dam is not expected to have material negative biodiversity impacts in the long term. Terrestrial and aquatic habitats in the area of influence of the dam have been significantly impacted over many years by subsistence cultivation, clearing of woodlands for firewood and charcoal and grazing for livestock. Habitat integrity in the area of influence of the dam is generally low due to decades of human activities. This is unlikely to change because of the remedial works on the dam. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. The major threat to these two species, the Nile tilapia, introduced into the Kafue River system, does not appear to be present near the dam's impoundment (Luangwa River system). While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam and there is no significant increase in downstream erosion caused by the stream that could be attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be settlements and the practice of cultivation in the seasonally wet parts of the dambos and general habitat degradation in the surrounding areas due to bush clearing and overgrazing and not attributed to the presence of the dam's impoundment. Key management requirements are to continue efforts to improve catchment conditions to protect the water resource.

Proposed Mitigation Measures

Proposed mitigation measures are detailed in this BMP. For the construction phase, key measures are:

- The contractor shall avoid carrying out any activities and cutting down of trees in the forested area on the immediate South-East of the dam. This area is significantly forested and host a myriad of fauna species observed;
- Use of old site access roads, camp site, borrow pits and working areas to avoid clearing of new areas;

- All vegetation clearing activities will be subject to approval by the Project and Environmental Manager on site;
- Clearing the *Tena tena* that is slowing forming a blanket-like thicket on the water surface within the reservoir
- Nonuse of indigenous timber/wood for construction works on site. Required timber or wood will be procured from licensed pine and/or eucalyptus dealers;
- Planting or seeding of alien or foreign flora species will not be allowed;
- Poaching (hunting) or killing of wildlife on site will not be permitted by the workers and will constitute breach of contract;
- Enforcement of speed limits;
- Vehicle and machinery operation will be restricted to daylight hours to avoid collisions with priority nocturnal and crepuscular fauna;
- No construction and related project activities will be permitted within dambos on site;
- Bush burning and or open fires in forested or vegetated areas will not be permitted;
  Training and capacity building: key employees and community members will be sensitized/trained in natural resources management, implementation of the BMP and their roles as well the importance of conservation. For the operational phase, key measures are to provide training and support to the local communities to manage livelihood activities in the catchment, encouraging protection and sustainable use of the aquatic resource provided by the dam. These are to include:
- Sensitizing the local community to sustainable fishing methods and the importance of conserving aquatic resources;
- Training the DMC to maintain the dam wall by removing woody vegetation, encouraging grass growth and controlling access by stock to minimize erosion paths;
- Supporting the local community to determine and implement sustainable farming practices in the dam catchment, by prohibiting cultivation in the riverine areas and around the perimeter of the dam, limiting habitat degradation due to clearing of woodlands and maintaining stocking ratios that do not result in significant overgrazing.

  This support will initially be provided by the UNOPs project team and in the long term by the Ministry of Agriculture, Forestry and Fisheries and DMC.

Mitigation measures for the vulnerable Three spotted tilapia and Green headed tilapia are presented in the BMP. The measures aim at avoiding any residual impacts on two species.

Objectives of the BDA

Overall Objective

The overall objective of this BMP is to guide the remedial works on Chikowa Dam. The implementation of the BMP will mitigate potential identified risks to the aquatic environment, terrestrial environment, and their associated livelihoods, and bring the dam's operational management into compliance with WB safeguards policies. Particular emphasis is put on the presence of sensitive habitats and species with a conservation status of concern (both flora and fauna).

Specific Objectives for Terrestrial Assessment

Specific Objectives of the Flora Assessment

i. To identify the botanical attributes of the project site, including:
   - Compilation of species lists of all observed flora species;
   - Description of the extent and type of native species present;
   - Ascertainment of the presence of threatened species or vegetation communities (per the IUCN Red List) ;

ii. To quantify the botanical attributes of the assessment site (if necessary), to:
   - Identify the species and size class found within the site, and determine the ecological/habitat significance of each; and
   - Map the locations of threatened flora species and indicate potential habitat for threatened species.

iii. To quantify the regeneration and invasive species status of the area.

Specific Objectives of the Fauna Assessment

i. To identify the fauna present in the area including:
   - Compilation of species lists of all observed fauna species;
   - Documentation of the presence of threatened species or animal communities (per the IUCN Red List);

ii. To quantify the faunal attributes of the assessment site (if necessary), to:
   - Determine species diversity within and around the project site, and determine the ecological/habitat significance of each;
   - Map the locations of threatened animal species and indicate potential habitat for threatened species;
   - Identify existing and potential invasive species and cross breeding status at the sites.

Specific Objectives for Aquatic Assessment

- Collect, collate and compile comprehensive baseline information on the aquatic and riverine ecosystems;
- Determine the significance of aquatic ecological impacts caused by the dams, taking direct, indirect and cumulative impacts into consideration;
- Identify and describe the potential structural and non-structural measures to at least maintain or still increase ecological flow downstream of the dams;
- Develop a Biodiversity Management Plan for the affected dams under the project.

METHODOLOGY

This section of the report outlines the methods adopted for the assessment of existing ecological habitats, flora and fauna on site.

Assessment Methodology

Spatial scale-procedures to determine sub-project's area of influence

Terrestrial

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence. The dam's area of influence was also determined using its estimated throwback. For this purpose, throwback used was 1.5Km adopted from the studies of the dam done by COWI in 2018. Taking the dam's throwback as a radius of a circle whose center is the middle point of the dam wall, a circle was drawn to determine the spatial extent of the dam's area of influence. Using this method, the determined area of influence for Chikowa Dam is shown in Figure 3-1. Sampling was done within the determined area of influence.

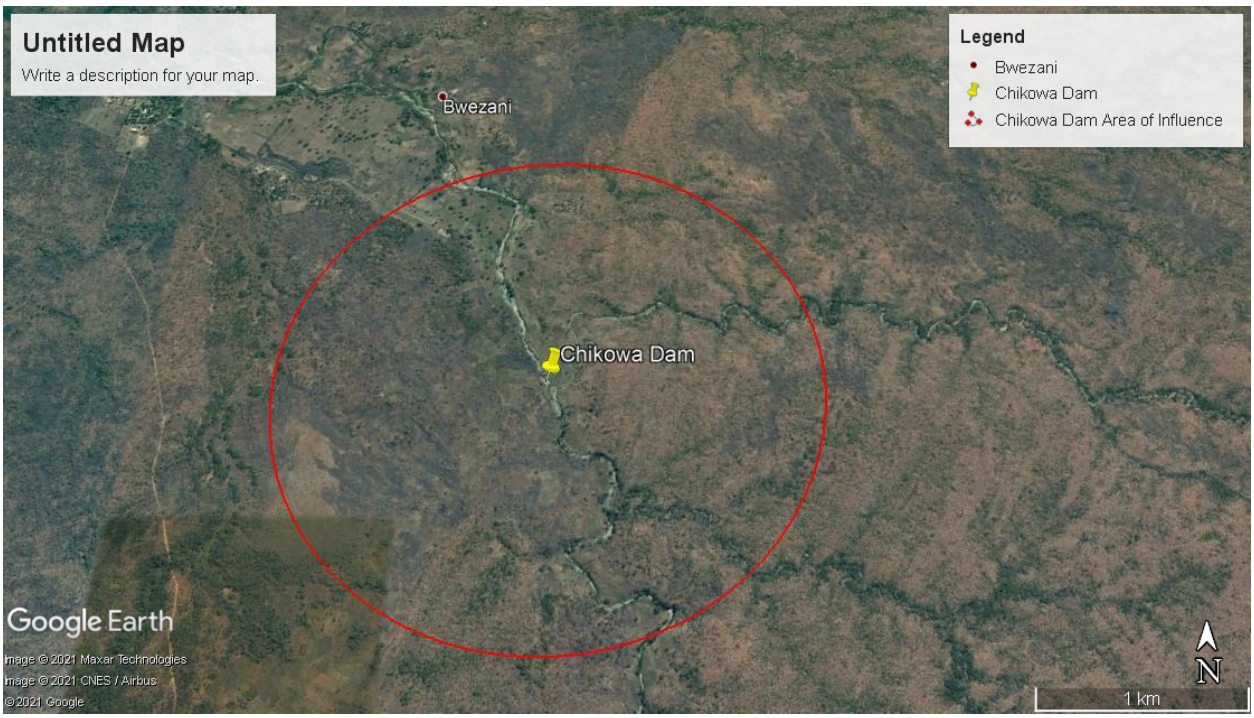


Figure 0-1: Chikowa Dam area of influence

Aquatic

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no

need to have a larger direct area of influence. Projects' area of influence for aquatic biodiversity assessments was determined by the extent of the water in the reservoir plus a 1km stretch upstream and downstream. A 1km distance down-stream was especially necessary to assess the impact in an event that the dam wall failed. This stretch was also considered adequate to understand the down-stream impact of the impoundment. Further, a 10-20m radius from the edges of either side of the dam and also the river was covered to understand riparian vegetation/flora.

Value of ecological resources and vulnerability of receptors

Terrestrial

In order to determine the value or integrity of terrestrial habitats, the criteria shown in Table 3-1 were adopted. Vulnerability of receptors was determined by employing the IUCN conservation status/value.

Table 0-1: Criteria for habitat integrity (William Latimer, 2009)

Criteria for defining habitat quality
High quality: • High degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • High species richness and diversity (i.e. represented by a large number of species from a range of flora and fauna groups). • High contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Provides known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Moderate quality: • Moderate degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • Moderate species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • Moderate levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Moderate contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Low quality: • Low degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • Low species richness and diversity (i.e. represented by a large number of species from a range of fauna groups).

- Low levels of foraging and breeding activity, with the site used by native fauna for refuge and cover.
- Unlikely to form part of a wildlife corridor, and/or connected to a larger area of high quality habitat.
- Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity).
- Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.

Determination of the quality or value of vegetation was done using the criteria presented in Table 3-2.

Table 0-2: Criteria for vegetation integrity

Criteria for defining vegetation condition
High quality: Vegetation dominated by a diverse indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate quality: Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer or ground cover.
Low quality: Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Aquatic

This section explains the criteria used in quantifying aquatic ecological resources in the project site. To evaluate instream and riparian ecosystems, the methodology developed by Kleynhans[21] (1996) was employed. Vulnerability of receptors was determined by employing the IUCN conservation status/value. Table 3-3 shows the criteria used for aquatic habitat integrity assessment.

Table 0-3: Criteria for aquatic habitat integrity (Kleynhans, 1996)

Criterion	**Relevance**
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon et al., 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included

[21] Kleynhans developed his habitat integrity index by using it on riparian and in stream habitats. Chibalashi reservoir is small-scale and the index was used mostly to evaluate the integrity of the riparian habitat and not the habitat of the reservoir per se.

Criterion	Relevance
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly, or alternatively indicated by human settlements, agricultural and industrial activities. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon et al., 1992).
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.

Descriptive classes for the assessment of modifications to habitat integrity were adopted from Kleynhans, 1996. These are shown in Table 3-4.

Table 0-4: Descriptive classes for the assessment of modifications to habitat integrity (Kleynhans, 1996).

Impact Category	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modification is present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 0-5: Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Flow modification	13	Exotic vegetation encroachment	12
Water quality	14	Exotic vegetation encroachment	12
Water abstraction	14	Inundation	11
Inundation	10	Water abstraction	13
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	7		
TOTAL	**100**	**TOTAL**	**100**

***NB**: Scores are then calculated based on ratings received from the assessment. The estimated impacts of the criteria are then summed and expressed as a percentage to arrive at a provisional habitat provisional habitat integrity assessment. The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 3-6.*

Table 0-6: Intermediate habitat integrity assessment categories (Kleynhans, 1996)

Category	Description	Score
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80 - 90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 - 59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 - 39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

Evaluation of significance of Impacts

In the criteria for the evaluation of impacts adopted for this study, the following factors were considered in classifying each potential impact generated by the sub-project:

- **Frequency:** Occurrence of activity producing the impact, e.g. continuous, intermittent or a single event/less than once per year;
- **Likelihood:** Probability of impact occurrence (e.g., 100%, 50%, 0%);
- **Extent:** Spatial extent of the impact (e.g. within 2km of site boundary, outside the Project site but within 20km, within 200km, within Zambia, outside Zambia.
- **Duration:** Extent in time of the impact. Short term impact (less than the life of the project), medium term impacts (equal to the lifetime of the Project) and long term impacts (greater than the lifetime of the Project);
- **Magnitude:** Impact magnitude defined in relation to the limit criterion specified by ZEMA or international standards where available.
- **Type of impact:** Positive or negative effect; direct or indirect action.
- **Potential significance:** A combination of all the factors described in the preceding bullet points is used to determine the type and significance of potential impact prior to mitigation. This is defined as low, medium or high.

Table 0-7: Terminology used to describe environmental and social impacts

Category	Terminology	Definition
Scope of Impact[(1)]		
Frequency	Frequent Infrequent Rare	Uninterrupted or on a daily basis Once or more per day Less than once per day Single event/less than once per year
Likelihood	Certain Likely Unlikely No impact	Impact possibility estimated to be 100% Impact possibility estimated as between 50% and 99% Impact possibility estimated as < 50% Zero estimated possibility of impact
Extent	Local Provincial Regional National International	Within 2 km of the Project site Outside the Project site but <20 km away Outside the Project site but < 200 km away Within Zambia Outside Zambia
Duration	Short Medium Long	Less than the life of sub-project The life of project Greater than the life of sub-project
Magnitude[(2)]	Very low Low Medium High Very high	Defined in relation to the limit criterion where available, e.g.: • Very low: Parameter < 10% limit criterion • Low: Parameter 10 to <50% limit criterion • Medium: Parameter 50 – 100% limit criterion • High: Parameter 100 – 200% limit criterion • Very High: Parameter > 200% limit criterion. Or, for qualitative assessments: • Very low: No degradation/adverse alteration to resource/receptor

Category	Terminology	Definition
		• Low: Minor degradation/adverse alteration to resource/receptor • Medium: Moderate degradation/adverse alteration to resource/receptor. • High: Significant degradation/adverse alteration to resource/receptor. • Very High: Permanent degradation/detrimental alteration to resource/receptor.
Type of Impact		
Effect	Positive Negative	Beneficial impact Adverse impact
Action	Direct Indirect	Impact caused solely by activities within scope of Project Impact which does not result directly from by activities within the scope of sub-project, but which has a connection with the sub-project's presence.
Potential Significance		
Significance	Low Medium High	Any low magnitude impact, or medium magnitude impact that is unlikely to occur or is of short duration. Any medium magnitude impact that is certain or likely to occur and of medium or long duration. Also, any high magnitude impact that is unlikely to occur, of short duration, or local in extent. Any high magnitude impact that is certain or likely to occur, of medium or long duration, and regional in extent.
(1) (2)	All terms are characteristics of the impact(s). For example, duration refers to duration of impact, not the activity causing it. As indicated, the impact magnitude for some environmental aspects can be defined in relation to the limit criterion specified by ZEMA or international regulations, or best practices when national standards are not available. However, in the absence of definitive quantitative criteria, a qualitative assessment of the magnitude is used relating to the impact type.	

Approach to mitigation of impacts

The conservation objectives and management actions in the BMP have been developed to ensure that the mitigation hierarchy is consistent with the WB's approach i.e. anticipate and avoid risks and impacts; where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels; once risks and impacts have been minimized, mitigate; and, when significant residual impacts remain, compensate for, or offset them when technically and financially feasible.

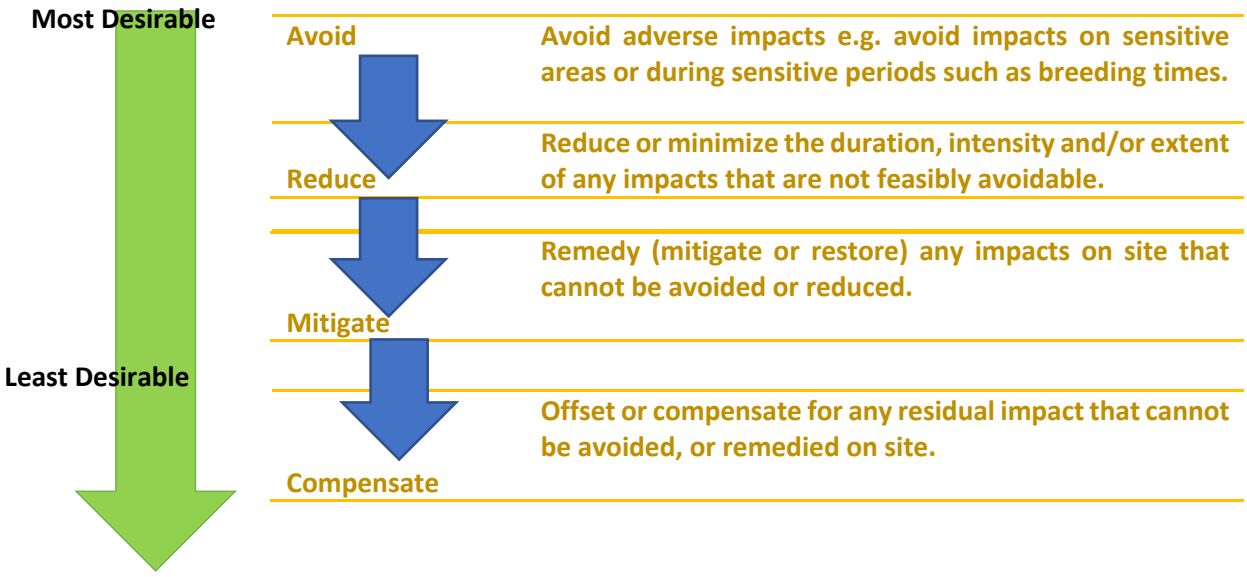


Figure 0-2: Impact mitigation hierarchy adopted

Data Collection Methods

Desk review

Desk study or review was done prior to undertaking site surveys. The purpose of the review was to help develop the study methodology and prepare for the field work. It was used to collect secondary data relevant for the terrestrial and aquatic ecological assessment.

Documents reviewed included but not limited to:

- Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia under the IDSP;
- Initial Environmental Project Brief for Chikowa Dam
- Various ecological studies including Zambia Environmental Management Agency Approved ESIAs and EPBs carried out in Southern Province with focus on those close to the project site
- Satellite images of the project site

The review also included internet research with the following websites being the main ones consulted:

- IUCN Red List;
- Birdlife Data Zone; and
- Ramsar Website

Completion of field surveys

Terrestrial field surveys

Chikowa Dam's Terrestrial field surveys were done over a period of three days (21st to 23rd April, 2021). The surveys were aimed at providing a broad understanding of the terrestrial ecology values of the study area, including vegetation composition, the presence or potential presence of conservation significant flora and fauna, and habitat suitability for fauna.

Flora surveys

A blend of three (3) sampling methods was used for the field flora survey within the project's area of influence. These methods were Stratified Random Sampling, Purposive Sampling and Point Counts.

Stratified Random Sampling was used because it was observed during desktop review via satellite images and the reconnaissance survey that the project site was highly fragmented. First, the project area of influence is split by the dam into the up and downstream as well as the East and West banks or sides. Additionally, Agricultural activities (maize, groundnuts, sunflower fields and vegetable gardens) and settlements within the project area of influence have further fragmented the site. Additionally, it was observed that the site had a number of diverse vegetation types or habitats such as Miombo woodlands, riparian and dambos. In order to assess vegetation in all the areas (upstream and downstream as well as sides of the dam), across all vegetation types (habitats), and in the available fragmentations, strata were made following these groups. Sampling within these strata was randomly done.

Purposive Sampling and Point Count was used in instances were species of interest are observed singularly or in a group at a point not marked for sampling. These were recorded and coordinates keyed in.

In total, 15 sampling plots were established. These plots were circular and had a radius of 20m translating into an approximate area of 1,256m^2 per plot. Therefore the total area sampled was 18,840m^2. For the sampling plots, the radius of 20m was chosen because studies have shown that circular plots with 12 to 20m radius capture adequate data in the inventory of the Zambezian phytoregion (Geldenhuys, 2004; Densanker, Frost, Justice, & Scholes, 1997; Zimba, 1991). Another advantage is that the circular plots are easier to establish in the field compared to square plots.

The initial plan was to set 20 sampling plots, but only 15 were done due to: lack of access to some portions of the site and the fact that most vegetated areas on site were homogenous in terms of vegetation characteristics. The coordinates for the locations of the sample plots is given in Appendix 1.

Table 3-8 shows the parameters that were taken from the main plots. All the measurements taken on the tree parameters from the main plot were recorded on the main plot data collection form (Appendix 2).

Table 0-8: Parameters measured from the main plot

Parameter	Comment
Diameter at Breast Height (DBH)	Taken on each tree in cm
Bole height	Taken in m
Total Height	Measured in m
Tree condition	Crooked, moribund, etc…
Tree species	Identified by use of check lists and KYT
Crown size	In m
Evidence of fire	
Health of canopy	In %
Vegetation type	Marquesia, Parinari forest etc

The data collection team comprised of 6 individuals divided into 2 groups. Each group had an Ecologist, Assistant Ecologist and a local person. The 20m radius plots were subdivided into semi-circle plots with each team handling one half of the plot. To ensure consistency in the data collection, a protocol was followed (Table 3-9).

Table 0-9: Flora data collection protocols

Flora Data Collection Protocols	
1	*Measuring tree diameter* • For trees with diameters greater than 5cm, measure diameter of the tree at 1.3 m from the ground • Record diameter to the nearest 0.5 cm • A leaning tree should always be recorded on the lower or underneath side • If the tree forks or there is some deformity at 1.3m, get diameter below the fork and above the deformity respectively and indicate the "forked" or "deformed" in the remarks column of the main form. • If the tree breaks into two or more stems at or near ground level record measure diameter at 1.3m of the biggest tree
2	*Measuring tree height* • Height is read to the nearest 1 meter • Ensure that the horizontal distance to the center of the tree from the observer is accurately taken • Ensure reading the correct scale • Ensure that the effect of lean on any measurement is corrected by taking readings from diametrically opposite points and average calculated or measurement to be taken at right angles to the plane of the lean. • Ensure that the device or instrument is in good working condition before use. • Always stand on the same level of ground as the tree, i.e. do not measure from up or down a slope but across the slope • If your vision is obstructed to the tip or top most branches of the tree either take a different baseline or estimate where the top is and record the height as estimated • If possible, always check the height using more than one baseline taken in different directions from the tree • If a tree is dead in its upper crown or dying back, the height recorded should be to the highest live branch, although the height it had reached will be of interest if not recorded before • For leaning trees get height from both sides (leeward and leaning)
3	*Regeneration* • Count all the tree species with diameter <5cm and height <50cm • Identify the tree species
4	*Health of canopy cover* • Measure the health of the canopy in percentage • Observe the canopy cover using the visual guide provided

In each main plot, six (3m x 3m) regeneration sub-plots were established. On these plots all seedlings below 5cm diameter and 50cm height were recorded. Regeneration measurement involved counting and identifying the species in the 3m x 3m plots. Regeneration data were recorded on the regeneration data collection form (see Appendix 3). Weeds were also identified.

Fauna assessment

Fauna assessments were done in all identified habitats or vegetation types on site. In line with this, the number of fauna study or assessment sites was determined by the number of habitats on site. Habitats

present in the area were identified during desk review via satellite images and confirmed during reconnaissance survey. Using these methods, identified habitats on site were: Riverine Vegetation (Riparian); Miombo woodlands; and Dambos (shallow wetlands). Miombo Woodlands on site have specialized habitats that include Anthills (Termitaria) and Hill Miombo.

Litter in the sampling plots was turned over in search of terrestrial macroinvertebrates, amphibians and reptiles. All species encountered were identified based on morphological features using field guides. Encountered fauna species were recorded on Fauna Data Sheet shown in Appendix 4.

The fauna survey involved direct observation (during daylight hours) of signs of activity which included prints, tracks, hairs, droppings, odour, digging and evidence of feeding.

To survey small mammals, standard Sherman traps were used (Figure 3-3). These traps were laid in strategic areas that were established following the nature of the habitats and sightings as testified by the locals. The traps were exposed for over 12 hours from 17:00 hours to 07:00 hours the following day. The trapped specimens were identified based on their morphological features using field guides. The Sherman Traps were baited with small balls of peanut butter mixed with maize meal and in some cases just Jungle Oats.

For birds, observations were made from 06:00 – 08:00 hours in the morning and 15:00 - 17:00 hours in the afternoon. Birds were identified based on their morphological features described by Sinclair et al. (2002) and Sinclair and Ryan (2010). They were further assessed through droppings; vocal availability; footprints; roost, flock and nesting structures. The data collected were recorded in the data recording form (Appendix 4).

Other survey techniques employed to assess the baseline fauna (including birds, mammals, reptile, amphibians and invertebrates) present in the project area of influence include:

- Point count and play back calls
- Field walks
- Direct search and observations
- Indirect method (noticing the presence of foot prints, tracks, droppings, burrows or digging and evidence of feeding)

Figure 0-3: Small mammal trapping using standard Sherman trap

To enhance the chances of observing various fauna in the project area of influence, camera traps were set in all observed habitat. The camera traps were left in the filed for two days and nights. Figure 3-4 shows the cameras set in the field. The cameras were set at knee height so that even small fauna can be captured.

Figure 0-4: Field Camera trap for fauna observation

Invertebrates: Observations for invertebrates were made directly while in the field. Litter in the sampling plots was turned over in search of terrestrial macroinvertebrates. Further, to enhance the chances of observing insects that are active on the ground, pit fall traps were set in the field. Two types of pit fall traps were used. These were cup sized traps (500ml) and bucket sized traps (10 litres).

Interviews: Community members, mainly members of the Chikowa DMC were interviewed for the purpose of collecting data on the type of animals; location, distribution and frequency of occurrence. Community members were also asked if any of the plants that were initially available in the area are now non-existent. Figure 3-6 shows a focus group discussion held with members of the Dam Management Committee regarding wildlife in the area.

Figure 0-5: Group interview with members of the Chikowa DMC on terrestrial and aquatic wildlife in the area.

The following key interview questions were used to collect data on wildlife resources in the area:

- What types of animals (mammals, birds, reptiles, amphibians and insects) were once present in the area?
- What animals are found in the area today? and
- What has caused the changes in animal population structures?
- For bird species, checklist of questions included:
- What type of migratory birds you usually see in the area?
- Do you notice any strange or extraordinary birds during certain seasons?
- Do you know their names?
- When do they appear and leave each season?

Aquatic field surveys
Data was collected on 3 consecutive days. That is on the 21st, 22nd and 23rd of April, 2021. On the first day, aside from collecting data on water quality, planktons, fish, invertebrates, aquatic flora and habitats, a reconnaissance survey was conducted.

Reconnaissance Survey: The team of two (lead ecologist and technician) undertook a reconnaissance survey of Chikowa Dam on 21st April, 2021 in the company of some community members. This exercise was cardinal as regards having an in-depth knowledge of the area. Further, it guided sampling protocols.

Selection of sampling points: Stratified and purposive sampling was employed in a bid to generate data required for the study. The reservoir and the stream were stratified into five strata. Namely upstream, the point where the stream enters the reservoir, midpoint of the reservoir, dam wall and downstream. This sampling design enhances chances of obtaining representative data on fauna, flora, water quality, planktons and habitats for the area under review. The coordinates for the sampling points indicated in table 3-10. Data captured at each one of the sampling points are recorded on the attached data sheets (Appendix 5)

Table 0-10: Coordinates for the points sampled

Coordinates		**Location Description**
S 13.43671 degrees	E032.10567 degrees	Downstream
S 13.29802 degrees	E 032.05996 degrees	At the weir
		Mid-section of reservoir
		Point of entry of stream into reservoir
S 13.44286 degrees	E032.21030 degrees	Upstream

Water Quality: A calibrated multi-water parameter checker was employed to measure water quality. In situ parameters considered in this study included temperature, pH, dissolved oxygen, conductivity and transparency. The sampling points were accessed by a boat.

Plankton: Water samples were collected in the field from sampling points using a plankton net In total, two water samples were collected at each sampling point. The collected water samples were fixed with 90% ethanol. The water samples were taken to the laboratory for analysis of planktons; and chemical parameters which were not addressed in-situ.

Fish: A variety of sampling gears were applied to sample fish species. The fishing gear used depended on the characteristics of the sampling station. The fishing gear included gill nets, long lining and seine net.

On average, fishing for samples was conducted for 2 hours during day time at a particular station. This being the case, it's possible to compute Catch per unit of effort (CpUE), which is an index of biomass.

Each individual fish captured at any sampling station was weighed and its length taken. Captured fish were identified to species level by using field guides developed by Skelton (2001) and Utsugi & Mazingaliwa (2002).

Macroinvertebrates Survey: Invertebrates on the surface of water were captured using a scoop net and identified using a guide developed by Sims & Blaylook (2002). For those invertebrates occupying the streambed, the streambed was deliberately disturbed by use of a stick in a bid to dislodge them. As the plume of the silt rose, the scoop net was employed to capture any dislodged invertebrates; which were identified using magnifying glass and a field guide (Sims & Blaylook, 2002).

Aquatic Flora: At each particular sampling station and within its vicinity, all aquatic plants were identified using a field guide developed by Carrothers (2016).

Habitat integrity: Since the area under review had 3 distinctly different components, namely upstream, reservoir and downstream, observational walks were undertaken along the length and breadth of each component to study the general attributes. Further, in the case of the reservoir, offshore observational excursions were taken by use of an inflatable boat.

Criteria for aquatic habitat integrity developed by Kleynhans (1996) were employed to ascertain the habitat integrity of each component (upstream, reservoir, downstream). This involved assessment of the instream and riparian components.

Interviews with community members: The Dam Management Committee members were interviewed (Fig.3-6). The interview was guided by following questions:

- What aquatic fauna/flora is found in the dam and the stream?
- What gear is employed in harvesting fish by fishers?
- What are the notable challenges with respect to securing the dam and its constituents?

Data Analysis

Terrestrial Data Analysis

Microsoft Excel was used to analyze the data on flora. The species data was used to determine species importance values (IV) and species richness. IVs were calculated as adopted from DWAF (2005). Species IV are useful in determining the performance of the species in a given area.

For plants with dbh ≥ 5 cm

$$\text{Importance value (IV)} = \frac{RF + RD + RBA}{3}$$

Where:

- RF = Relative Frequency;
- RD = Relative Density; and
- RBA = Relative Basal Area.

IV measures the relative dominance of species in a forest community (Curtis & Mcintosh, 1959). IV rank species within a site based upon three criteria:

1. How commonly a species occurs across the entire forest area
2. The total number of individuals of the species and
3. The total amount of forest occupied by the species

Before calculating the IVs, Relative Frequency (RF), Relative Density (RD), Relative Basal Area (RBA), and Abundance of each tree species encountered was calculated. To calculate RF, RD and RBA, the following formulae were used:

$$\text{Relative frequency} = \frac{\text{Number of plots in which species is present} * 100}{\text{Total number of plots recorded}}$$

$$\text{Relative density} = \frac{\text{Number of stems recorded for species} * 100}{\text{Number of stems recorded for all species}}$$

$$\text{Abundance} = \frac{\text{Total Number of stems recorded for species}}{\text{Total number of quadrants in which the species occurred}}$$

$$\text{Relative basal area} = \frac{\text{Basal area of a species in a community} * 100}{\text{Total basal area of all species in the community}}$$

Regarding fauna, field guides were used to identify the encountered species based on morphological features. Paw prints were compared against those in field guide books for fauna identification. Animal droppings observed were identified based on shape and constituents. In this case, field guide book was also used.

Aquatic data analysis

During this survey, data were collected on fish, invertebrates, flora, water quality, planktons and habitats. This section provides a breakdown of how the data was analyzed.

Microsoft excel (2008) was used to analyze fish data. Further, Catch Per Unit Effort (CpUE) for a particular gear was computed using the formula:

Catch Per Unit Effort (CpUE) = Total catch of fish (Kg)/Fishing Effort (Time in hrs).

Additionally, the IUCN red list of threatened species was employed to guide on the conservation status of fish. With respect to flora and invertebrates, here too the IUCN red list of threatened species was employed to ascertain their conservation status.

Reference values for pH, dissolved oxygen, conductivity and water transparency were used to explain the water quality values obtained in-situ.

In order to ascertain whether the direct area of influence is modified/converted or natural, a habitat integrity analysis was conducted using a tool designed by Kleynhans (1996).

Water samples containing planktons, were taken to the Department of Fisheries for identification. Analysis of chemical parameters of water samples not measured in-situ was conducted at The University of Zambia.

Results and Discussion

Terrestrial Survey Results

Habitats

Three types of habitats were identified within Chikowa Dam's area of influence. These were: Miombo Woodlands; Riverine or Riparian and Dambos or shallow wetlands. Miombo Woodlands on site host sporadic specialized including Hill Miombo and Termitaria habitats.

Dambos on site are typically characterized by grasses, rushes and sedges. Riparian vegetation near the dam is not very different from the general Miombo on site because the original Riverine Vegetation has been submerged by the inundation of the dam (Fig. 4-1).

The vegetation in Miombo Woodlands is dominated by *Julbernadia Paniculata*, *Diospyros kirki, Diplorhyncas condilocarpon, Combretum zeheri, Brachystegia Boehmii* and *Colophospermum Mopane*.

The area that is on the immediate South East of the dam is relatively intact or natural in terms of vegetation cover. This may be due to the poor and rocky soils, which limit agricultural activities in the area.

Figure 0-6: Submerged trees that were part of the original riverine vegetation

In terms of value or importance, the three main habitats are classified in Table 4-1, with reasons for the classification given.

Table 0-11: Evaluation of the importance or value of habitats on site

Type of Habitat		Classification Value (importance)	Reasons for Classification
1.	Miombo Woodlands		
	a. Low Lying Miombo	Low	• With an exception of the South East side of the dam, low lying Miombo Woodlands in the Project area of influence have been degraded and highly fragmented by anthropogenic activities such as crop agriculture and settlements • The area has been invaded by invasive species that mainly include Milk Weed (*Asclepis)*, *Lantana camara* and *Helianthus tuberosus* (Fig. 4-2)
	b. Hill Miombo	Medium	• Though there are signs of minimal disturbances, This type of habitat mostly found on the immediate South East of the dam is relatively intact with most trees having diameters greater than 20cm • Vegetation structures can be clearly identified in these habitats on site • Signs of fauna presence were mainly observed in Hill Miombo • No invasive species were observed in Hill Miombo habitats • No settlements were observed in these specialized Miombo woodlands
2.	Riparian or Riverine	Low	Most of the original riverine vegetation in the vicinity of the dam has been submerged by the dam's inundation (Fig. 4-1). This has resulted in mortality. At the time of the survey, it was observed that this is when the 'new' Riparian vegetation is establishing itself.
3.	Dambos	Medium	• Most dambos observed in the area are sparingly used for cattle and goats grazing. In some cases, gardening is done in these habitats.

The overall, the observed disturbances in the habitats on site can be solely attributed to human activities like settlements; agriculture; gardening; and cattle and goats grazing. The invasive Milk Weed was possibly introduced on site through laterite and waste rock which was brought for the dam's construction purposes by prior works.

Figure 0-7: Invasive alien species observed within the subproject area of influence

Flora

A total area of 18,840m^2 was sampled for the purpose of the flora survey within Chikowa Dam's area of influence.

Within the sampled area, a total number of 22 tree species were recorded. The overall stem across all species recorded was 713 translating into a stocking of 376 Stems/ha. The average tree DBH recorded was 19.9cm. The relatively healthy average DBH is attributed to almost intact Miombo Woodlands on the South Eastern part of the dam.

The Relative Frequency, Relative Density, Abundance, Relative Basal Area, and the Importance Value of all species recorded are presented in Table 4-2.

Important values (IV) measure the relative dominance of species in a forest community (Curtis, 1959). IV rank species within a site based upon three criteria:

a) How commonly a species occurs across the entire forest area,
b) The total number of individuals of the species and
c) The total amount of forest occupied by the species

Table 0-12: Relative frequency, relative density, relative basal area and important values

Species Name	No. of stems	Relative Frequency	Relative Density	Abundance	Total Basal Area	Relative Dominance	Importance Value	IUCN Status
Acacia conilum	11	3.33	1.51	5.50	0.46667	0.154496	14.89	LC
Acacia nilotica	39	20.00	5.34	13.00	2.73692	0.255563	25.43	LC
Acacia polyacantha	15	13.33	2.05	7.50	0.30960	0.075164	15.41	LC
Acacia tortilis	29	20.00	3.97	9.67	1.48705	0.186736	24.03	LC
Annona senegalensis	15	13.33	2.05	7.50	0.25843	0.062742	15.41	LC
Bauhinia petersiana	35	40.00	4.79	5.83	0.76032	0.079110	44.82	LC
Brachystegia boehmii	40	40.00	5.48	6.67	1.89369	0.172405	45.54	LC
Cassia abreviata	19	13.33	2.60	9.50	0.88273	0.169189	15.99	LC
Colophospermum mopane	25	33.33	3.42	5.00	1.14341	0.166556	36.81	LC
Combretum colinum	29	20.00	3.97	9.67	0.44393	0.055746	23.99	LC
Combretum imberbe	14	13.33	1.92	7.00	0.70168	0.182521	15.31	LC
Combretum zeheri	46	46.67	6.30	6.57	2.15827	0.170863	53.02	LC
Diospyros kirki	60	46.67	8.22	8.57	2.18670	0.132720	54.93	LC
Diplorhyncas condilocarpon	60	46.67	8.22	8.57	1.58352	0.096110	54.92	LC
Julbernadia paniculata	169	80.00	23.15	14.08	7.71022	0.166142	93.6	LC

Kirkia acuminata	11	6.67	1.51	11.00	0.46067	0.152508	8.22	LC
Lannea discolor	18	20.00	2.47	6.00	0.68495	0.138575	22.51	LC
Pseudolachynostalis maproneifolia	5	6.67	0.68	5.00	0.03959	0.028835	7.36	LC
Pterocarpus angolensis	8	6.67	1.10	8.00	0.03285	0.014953	7.77	LC
Sclerocaria caffra	17	20.00	2.33	5.67	0.36179	0.077501	22.35	LC
Steculia quiqueloba	34	26.67	4.66	8.50	0.97328	0.104246	31.36	LC
Ziziphus abyssinica	14	13.33	1.92	7.00	0.18786	0.048865	15.27	LC

From Table 4-2 *Julbernadia Paniculata* had the highest IV (93.60%) followed by *Diospyros kirki* (54.93%), *Diplorhyncas condilocarpon* (54.92%) and *Combretum zeheri* with 53.02%. The four species with the least IV were: *Pseudolachynostalis maproneifolia* (7.36%), *Pterocarpus angolensis* (7.77%), *Kirkia acuminate* (8.22%) and *Acacia conilum* (14.89%).

Based on the analysis results, the conclusion is that the most dominant, common or abundant flora species within the sub project area of influence are *Julbernadia Paniculata*, *Diospyros kirki*, *Diplorhyncas condilocarpon* and *Combretum zeheri*.

No IUCN red List Threatened, Endangered or Critically Endangered flora species were encountered in the project area of influence during the survey.

It was revealed during the study that Chinese firms in the Mambwe District and Eastern Province at large have found medicinal and commercial (mainly timber) uses for Mopane, *Colophospermum mopane* and they are paying locals to harvest this tree species for them. Pockets of areas from which Mopane, *Colophospermum mopane*, has been heavily harvested were observed. This has led to the decrease in the local population of *Colophospermum mopane.*

Frequency refers to the degree of dispersion in terms of percentage occurrence (Shukla and Chandel 2000). The species that is not well distributed will occur in few quadrants and as such their frequency will be low. Higher frequency implies that the species is widely spread in the area. The abundance of the species was determined and assigned to abundance classes such as Rare (1≤F≤4); Occasional (5≤F≤14); Frequent (15≤F≤29); Abundant (30≤F≤90) and Very Abundant (100+) per square meter quadrant (Table 4-3).

Table 0-13: Abundance Classes for sampled tree species

Species Name	Relative Frequency	Abundance Class
Julbernadia paniculata	80	Abundant
Combretum zeheri	46.67	Abundant
Diospyros kirki	46.67	Abundant
Diplorhyncas condilocarpon	46.67	Abundant
Bauhinia Petersiana	40	Abundant
Brachystegia Boehmii	40	Abundant
Colophospermum mopane	33.33	Abundant
Steculia quiqueloba	26.67	Frequent
Acacia nilotica	20	Frequent
Acacia tortilis	20	Frequent
Combretum colinum	20	Frequent
Lannea discolor	20	Frequent
Sclerocaria caffra	20	Frequent
Acacia conilum	13.33	Occasional
Acacia polyacantha	13.33	Occasional
Annona senegalensis	13.33	Occasional
Cassia abreviata	13.33	Occasional
Combretum imberbe	13.33	Occasional

Species Name	Relative Frequency	Abundance Class
Ziziphus abyssinica	13.33	Occasional
Kirkia acuminata	6.67	Occasional
Pseudolachynostalis maproneifolia	6.67	Occasional
Pterocarpus angolensis	6.67	Occasional

In terms of Frequency or how well a species is spread across the study area, none of the recorded flora was classified as Very Abundant. This is attributed to the fact that vegetation in the area has been exploited or cleared for various reasons including agriculture, construction, settlements and fencing. Seven (7) of the recorded twenty two (22) species were found to be found to be Abundant. These were *Julbernadia Paniculata*; *Combretum zeheri*; *Diospyros kirki*; *Diplorhyncas condilocarpon*; *Bauhinia Petersiana*; *Brachystegia Boehmii;* and *Colophospermum Mopane*. Six (6) were Frequent while nine (9) were Occasional. No recorded tree species had an abundance class of Rare. This means that no species in the area is locally threatened or endangered per IUCN Red List.

The extrapolated stocking (stems/ha) value for the whole sampled area was 376 Stems/ha. This indicates a low stocking or degraded Miombo because high value Miombo Woodlands usually have the stocking of at least 500 Stems/ha. In terms of specific species, *Julbernadia Paniculata* had the highest number of stems with 169 representing 23.7% of the total stems. It is followed by *Diospyros kirki* and *Diplorhyncas condilocarpon* each with 60 stems (8.42%); *Combretum zeheri* with 46 stems (6.45%) and fourth was *Brachystegia Boehmii* with 40 stems representing 5.61%. Extrapolated number of Stems per hectare for all observed tree species is shown in Table 4-4.

Table 0-14: Stocking or stems per hectare within the Project area of influence

Species Name	No. of stems	Stocking (Stems/ha)	% Total
Julbernadia paniculata	169	88.95	23.70
Diospyros kirki	60	31.58	8.42
Diplorhyncas condilocarpon	60	31.58	8.42
Combretum zeheri	46	24.21	6.45
Brachystegia boehmii	40	21.05	5.61
Acacia nilotica	39	20.53	5.47
Bauhinia petersiana	35	18.42	4.91
Steculia quiqueloba	34	17.89	4.77
Acacia tortilis	29	15.26	4.07
Combretum colinum	29	15.26	4.07
Colophospermum Mopane	25	13.16	3.51
Cassia abreviata	19	10	2.66
Lannea discolor	18	9.47	2.52
Sclerocaria caffra	17	8.95	2.38
Acacia polyacantha	15	7.89	2.10
Annona senegalensis	15	7.89	2.10
Combretum imberbe	14	7.37	1.96
Ziziphus abyssinica	14	7.37	1.96

Species Name	No. of stems	Stocking (Stems/ha)	% Total
Acacia conilum	11	5.79	1.54
Kirkia acuminata	11	5.79	1.54
Pterocarpus angolensis	8	4.21	1.12
Pseudolachynostalis maproneifolia	5	2.63	0.70
Totals	**713**		**100.00**

Regeneration: A total number of 25 species were noted under regeneration with a combined number of stems of 2,632. These numbers show that the project area of influence is fairly performing in terms of regeneration and with proper management can recover from the anthropogenic activities that have degraded its vegetation. The number of wildlings recorded translates into a stocking of 1,386 Stems/ha showing a moderately healthy rejuvenation rate.

At species level, *Julbernadia Paniculata* had the highest number of wildlings' stems recorded with 211 stems representing 8.02% of the total followed by *Brachystegia Boehmii* with 146 stems (5.55%) and *Colophospermum mopane* with 132 stems (5.02%).

Acacia nilotica had the least number of wildlings recorded with 67 (2.55%) while *Sclerocaria caffra* was second lowest with 73 wildling stems representing 2.77% of the total. Overall, all the wildlings recorded were abundant in terms of Frequency, relative density and Importance Value. Table 4-5 shows the number of stems and percentage of the total for all wildlings in the sampled area.

It should be noted that none of the recorded flora species under regeneration has been listed as Threatened, Near Threatened, Endangered or Critically Endangered.

Table 0-15: Regeneration in sampled area

Species Name	Number of stems	% of the Total	IUCN Status
Julbernadia paniculata	211	8.02	LC
Brachystegia boehmii	146	5.55	LC
Colophospermum mopane	132	5.02	LC
Pterocarpus angolensis	126	4.79	LC
Diplorhyncas condilocarpon	122	4.64	LC
TerminaliabBrachysterma	119	4.52	LC
Bauhinia Petersiana	115	4.37	LC
Pseudolachynostalis maproneifolia	114	4.33	LC
Annona senegalensis	111	4.22	LC
Diospyros kirki	105	3.99	LC
Acacia polyacantha	102	3.88	LC
Combretum zeheri	99	3.76	LC
Terminalia stuhmanii	98	3.72	LC
Acacia tortilis	97	3.69	LC
Ziziphus abyssinica	97	3.69	LC
Combretum colinum	93	3.53	LC
Steganotania aralucea	92	3.50	LC

Steculia quiqueloba	91	3.46	LC
Cassia abreviata	90	3.42	LC
Acacia conilum	87	3.31	LC
Kirkia acuminata	87	3.31	LC
Lannea discolor	84	3.19	LC
Combretum imberbe	74	2.81	LC
Sclerocaria caffra	73	2.77	LC
Acacia nilotica	67	2.55	LC
Totals	**2632**	**100.00**	

Fauna

Mammals in the sub-project area of influence

A total number of 28 mammal species were recorded or observed within the subproject area of influence. None of the 28 recorded species is listed as Near threatened, Vulnerable, Endangered, or Critically Endangered under the IUCN Red List. The most commonly observed mammal species in the area are: Scrub Hare, *Lepus saxatilis*; Bush Squirrel, *Xerus inauris*; Field Mouse, *Apodemus sylvaticus*; Dwarf Mongoose, *Helogale parvula*; and African Civet, *Civettictis civetta*.

Observed signs of occurrence for mammals in the project area of influence are shown in Figure 4-2. The full list of Mammals recorded in the project area of influence is presented in Table 4-6.

Table 0-16: List of Mammals recorded in the area

No.	Scientific Name	Common Name	IUCN Status
1	*Tragelaphus strepsiceros*	Kudu	LC
2	*Hystrix cristata*	Porcupine	LC
3	*Elephantulus brachyrhynchus*	Short-snouted sengi	LC
4	*Aepyceros melampus melampus*	Common impala	LC
5	*Cercopithecus aethiops*	Vervet monkey	LC
6	*Papio ursinus*	Chacma baboon	LC
7	*Helogale parvula*	Dwarf mongoose	LC
8	*Genetta genetta*	Common genet	LC
9	*Felis lybica*	African wild cat	LC
10	*Cryptomys hottentotus*	Common mole-rat	LC
11	*Otolemur crassicaudatus*	Thick-tailed Bush-baby	LC
12	*Sylvicapra grimmia*	Common duiker	LC
13	*Lepus saxatilis*	Scrub hare	LC
14	*Xerus inauris*	Bush squirrel	LC
15	*Paraxerus cepapi*	Tree squirrel	LC
16	*Potamochoerus porcus*	Wild pig	LC
17	*Phacochoerus aethiopicus*	Warthog	LC
18	*Thryonomys swinderianus*	Greater cane rat	LC
19	*Vulpes chama*	Fox	LC

20	*Rattus rattus*	Black rat	LC
21	*Cryptomys mechowi*	Giant mole rat	LC
22	*Cryptomys hottentotus*	Common mole Rat	LC
23	*Philantomba monticola*	Blue duiker	LC
24	*Canis adustus*	Side-striped Jackal	LC
25	*Civettictis civetta*	African civet	LC
26	*Mellivora capensis*	Honey badger	LC
27	*Graphiurus murinus*	Woodland dormouse	LC
28	*Rousettus aegyptiacus*	Egyptian fruit bat	LC

Chikowa Dam area is near the South Luangwa National Park and portions of the area fall within the Malambo Game Management Area (GMA). Because of this, various animals which are not resident in the subproject area of influence of interest, visit the area in search of food and water (in times of shortages in the park and GMA). Other animals may just use the area as a transit route. Animals that fall in this category and have been sighted by interviewed community members are shown in Table 4-7.

Table 0-17: Animals not resident in the area, but who may sporadically visit the site

No.	Scientific Name	Common Name	IUCN Status
1	*Panthera leo*	Lion	CR
2	*Loxodonta africana*	Elephant	EN
3	*Panthera pardus*	Leopards	VU
4	*Hippopotamus amphibius*	Hippopotamus	VU
5	*Giraffa camelopardalis*	Giraffe	VU
6	*Crocuta Crocuta*	Spotted Hyena	LC
7	*Syncerus caffer*	Buffalo	NT

a). Otter, *Aonyx capensis* droppings - 'spraints'

b). Common Duiker, *Sylvicapra grimmia* droppings

Kudu, *Tragelaphus strepsiceros* droppings

African Civet, *Civettictis civetta* droppings

Figure 0-8: Signs of mammals' occurrence in the sub-project area of influence

Reptiles

The study recorded a total number of 26 reptile species. These were mainly snakes and lizards. The low number of reptile observed is attributed to the fact that reptiles are usually well camouflaged and are difficult to observe on site over a short period of time. Table 4-8 shows all reptiles recorded during the survey.

Table 0-18: Reptiles present in the Chikowa area

No.	Scientific Name	Common Name	IUCN Status
1	*Trachylepsis striata*	Striped skink,	LC
2	*Meroles squamulosus*	Common rough-scaled lizard	LC
3	*Heliobolus lugubris*	Bushveld lizard	LC
4	*Varanus albigularis*	Rock monitor	LC
5	*Varanus niloticus*	Water monitor	LC
6	*Chamaeleo dilepis*	Flap-necked chameleon	LC
7	*Trachylepsis striata*	Striped skink	LC
8	*Heliobolus lugubris*	Bushveld lizard	LC
9	*Agama atra*	Southern rock agama	LC
10	*Acanthocerus atricollis.*	Tree agama	LC
11	*Naja melanoleuca*	Forest cobra	LC
12	*Stigmochelys pardalis*	Leopard tortoise	LC
13	*Denroaspis angusticeps*	Green mamba	LC
14	*Chamaeleo lavigatus*	Chameleon	LC
15	*Gonionotophis capensis*	Common file snake	LC
16	*Naja nigricollis nigricincta*	Black–necked Spitting Cobra	LC
17	*Python sebae*	African rock python	LC
18	*Bitis arietans*	African Puff-adder	LC
19	*Dendroaspis polylepis*	Black mamba	LC
20	*Thelotornis capensis*	Twig or Vine Snake	LC
21	*Psammophis mossambicus*	Olive grass snake	LC
22	*Dispholidus typus*	Boomslang	LC
23	*Varanus exanthematicus*	Monitor lizard	LC
24	*Pelomedusa subrufa*	Marsh terrapin	LC
25	*Acanthocerus atricollis*	Southern tree agama	LC
26	*Psammophis mossambicus*	Olive grass snake	LC

Birds

The Chikowa dam area is very rich in avifauna with 95 species observed over a period of three (3) days. The field survey revealed that the area does not host any vulnerable and endangered species. None of the Vulnerable, Endangered, and Critically Endangered species listed in the Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia by the World Bank were observed in the project area of influence. However, literature review showed that these birds are present in South Luangwa National Park which is within 50Km of the proposed project site. It is likely that the IBAT datazone captured the fauna in a larger area than the dam itself. Figure 4-4 shows some of the signs of the presence of birds observed while the full list is given in Table 4-9.

a). Helmeted guineafowl, *Numida meleagris* feathers

b). Holub's golden weaver, *Ploceus xanthops'* nests

Figure 0-9: Some signs of birds' presence observed within the subproject area of influence

Table 0-19: List of all bird species observed within the subproject area of influence

No	Scientific name	Common name	IUCN Status
1	*Ploceus xanthops*	Holub's golden weaver	LC
2	*Crithagra mozambica*	Yellow-fronted Canary	LC
3	*Crithagra atrogularis*	Black-throated Canary	LC
4	*Phyllastrephus terrestris*	Terrestrial brownbul	LC
5	*Sylvia borin*	Garden warbler	LC
6	*Cisticola juncidis*	Zitting (Fan-tailed) Cisticola	LC
7	*Terpsiphone viridis*	African paradise-flycatcher	LC
8	*Lanius collaris*	Common fiscal shrike	LC
9	*Laniarius aethiopicus*	Tropical boubou	LC
10	*Dryoscopus cubla*	Black-backed Puffback Shrike	LC
11	*Micronisus gabar*	Gabar goshawk	LC
12	*Scopus umbrette*	Hamerkop	LC

No	Scientific name	Common name	IUCN Status
13	*Phoeniculus purpureus*	Green wood-hoopoe	LC
14	*Ploceus capensis*	Cape weaver	LC
15	*Ploceus subaureus*	Golden weaver	LC
16	*Cinnyris manoensis*	Miombo double-collared sunbird	LC
17	*Chalcomitra amethystina*	Amethyst (black) sunbird	LC
18	*Chalcomitra senegalensis*	Scarlet-chested sunbird	LC
19	*Anthreptes longuemarei*	Western violet-backed sunbird	LC
20	*Ploceus bicolor*	Forest weaver	LC
21	*Muscicapa striata*	Spotted flycatcher	LC
22	*Motacilla aguimp*	African pied wagtail	LC
23	*Lybius torquatus*	Black-collard Barbet	LC
24	*Pogoniulus chrysoconus*	Yellow-fronted Tinkerbird	LC
25	*Dendropicos namaquus*	Bearded woodpecker	LC
26	*Mirafra rufocinnamomea*	Flappet lark	LC
27	*Hirundo rustica*	European swallow	LC
28	*Oriolus larvatus*	Black-headed Oriole	LC
29	*Corvus albus*	Pied crow	LC
30	*Turdoides jardineii*	Arrow-marked Babbler	LC
31	*Cinnyricinclus leucogaster*	Violet-Backed (Plum-coloured) Starling	LC
32	*Zosterops senegalensis*	African yellow white-eye	LC
33	*Cinnyris venustus*	Variable (yellow-bellied) sunbird	LC
34	*Cinnyris talatala*	White-bellied sunbird	LC
35	*Cinnyris cupreus*	Copper (coppery) sunbird	LC
36	*Ploceus cucullatus*	Village (spotted-backed) weaver	LC
37	*Anaplectes melanotis*	Red-headed weaver	LC
38	*Ploceus velatus*	Masked weaver	LC
39	*Centropus senegalensis*	Senegal coucal	LC
40	*Quelea quelea*	Red-billed Quelea	LC
41	*Euplectes orix*	Southern Red-bishop	LC
42	*Euplectes afer*	Yellow-Crowned (Golden) bishop	LC
43	*Euplectes capensis*	Yellow Bishop (Cape/Yellow-Rumped widow)	LC
44	*Spermestes cucullata*	Bronze mannikin	LC
45	*Uraeginthus angolensis*	Blue waxbill	LC
46	*Estrilda astrild*	Common waxbill	LC
47	*Vidua macroura*	Pin-tailed Whydah	LC
48	*Urocolius indicus*	Red-faced Mousebird	LC
49	*Colius striatus*	Speckled mousebird	LC
50	*Halcyon senegalensis*	Woodland kingfisher	LC
51	*Halcyon albiventris*	Brown-headed Kingfisher	LC
52	*Halcyon chelicuti*	Striped kingfisher	LC
53	*Streptopelia decipiens*	African mourning dove	LC
54	*Pycnonotus tricolor*	Dark-capped (black- eyed) bulbul	LC
55	*Streptopelia semitorquata*	Red-eyed dove	LC
56	*Streptopelia capicola*	Cape turtle (ring-necked) dove	LC

No	Scientific name	Common name	IUCN Status
57	*Turtur chalcospilos*	Emerald-spotted wood-dove	LC
58	*Oena capensis*	Namaqua dove	LC
59	*Treron calvus*	African green pigeon	LC
60	*Bubulcus ibis*	Cattle egret	LC
61	*Poicephalus suahelicus*	Grey-headed parrot	LC
62	*Poicephalus meyeri*	Meyer's (brown) parrot	LC
63	*Macrodipteryx vexillarius*	Pennant-winged nightjar	LC
64	*Merops pusillus*	Little bee-eater	LC
65	*Coracias caudatus*	Lilac-breasted roller	LC
66	*Halcyon leucocephala*	Grey-headed kingfisher	LC
67	*Dicrurus adsimilis*	Fork-tailed drongo	LC
68	*Muscicapa adusta*	African dusky flycatcher	LC
69	*Hirundo rustica*	Barn (european) swallow	LC
70	*Sylvietta rufescens*	Long-billed crombec	LC
71	*Camaroptera brevicaudata*	Grey-backed camaroptera	LC
72	*Tauraco schalowi*	Schalow's turaco	LC
73	*Prinia subflava*	Tawny-flanked prinia	LC
74	*Cercropis cucullate*	Greater striped swallow	LC
75	*Emberiza cabanisi*	Cabanis's bunting	LC
76	*Dendropicos griseocephalus*	Olive woodpecker	LC
77	*Dendropicos fuscescens*	Cardinal woodpecker	LC
78	*Gallinula chloropus*	Common moorhen	LC
79	*Amaurornis flavirostra*	Black crake	LC
80	*Milvus aegyptius*	Yellow-billed kite	LC
81	*Pytilia afra*	Orange-winged (golden-backed) pytilia	LC
82	*Lagonosticta nitidula*	Brown firefinch	LC
83	*Lagonosticta rubricata*	African (blue-billed) firefinch	LC
84	*Numida meleagris*	Guinea fowl	LC
85	*Lagonosticta rhodopareia*	Jameson's firefinch	LC
86	*Plocepasser mahali*	White-browed sparrow-weaver	LC
87	*Corvinella melanoleuca*	Magpie shrike	LC
89	*Burhinus capensis*	Spotted thick-knee	LC
90	*Cursorius temminckii*	Temminck's courser	LC
91	*Dendroperdix sephaena*	Crested francolin	LC
92	*Oxylophus jacobinus*	Jacobin cuckoo	LC
93	*Clamator glandarius*	Great spotted cuckoo	LC
94	*Caprimulgus rufigena*	Rufous-cheeked night jar	LC
95	*Bubo africanus*	Spotted eagle-owl	LC

4.1.3.4 Amphibians

Amphibians observed within the project were primarily frogs and toads. Of these, the most common or wide spread was the Grey Foam-Nest Tree Frog, *Chiromantis xerampelina* and the Plain Grass Frog, *Ptychadena anchieta.* Interviewed, community members highlighted that the Giant Bull Frog, *Pyxicephalus adspersus* was very common in the past. The decline in number is attributed to the fact that

Giant Bull Frog, *Pyxicephalus adspersus* is a local delicacy. Table 4-10 shows the full list of Amphibians encountered within the project site.

None of the recorded amphibian species is listed as Threatened, Endangered, or Critically Endangered as per IUNC Red List status.

Figure 0-10: Eastern Olive Toad, *Sclerophrys garmani* observed within the sub-project area of influence

Table 0-20: List of amphibians observed in the sub-project area of influence

No.	Scientific Name	Common Name	IUCN Status
1	*Sclerophrys garmani*	Eastern olive toad	LC
2	*Kassina senegalensis*	Bubbling kassina	LC
3	*Phrynobatrachus natalensis*	Snoring puddle frog	LC
4	*Amietia quecketti*	Common river frog	LC
5	*Chiromantis xerampelina*	Grey foam-nest tree frog	LC
6	*Ptychadena anchietae*	Plain grass frog	LC
7	*Sclerophrys pusilla*	Toad	LC
8	*Pyxicephalus adspersus*	Giant bull frog	LC
9	*Strongylopus bonaspei*	Striped stream frog	LC
11	*Amietophrynus gutturalis*	Guttural toad	LC

Invertebrates

A total number of 52 species of invertebrates were identified during the survey. Of these, grasshoppers were the most abundant accounting for 13 species followed by crickets with 7 species. None of the identified invertebrates are listed as vulnerable or endangered under the IUCN status. A full list of invertebrates encountered in the field are shown in Table 4-11.

Table 0-21: Invertebrates observed on site

No.	Scientific Name	Common Name	IUCN Status
1	*Eronia cleodora*	Vine-leaf vagrant	LC
2	*Archispirostreptus gigas*	Giant millipede	LC
3	*Ictinogomphus ferox*	Dragon fly	LC

No.	Scientific Name	Common Name	IUCN Status
4	*Family Pentatomidae*	Stink bug,	LC
5	*Phymeurus granulatus*	Grasshoppers	LC
6	*Cannula gracilis*		LC
7	*Glyphoclonus miripennis*		LC
8	*Machaeridia conspersa*		LC
9	*Odontomelus zambiensis*		LC
10	*Chokwea bredoi*		LC
11	*Aulacobothrus dorsatus*		LC
12	*Pnorisa squalus*		LC
13	*Acrida acuminata*		LC
14	*Gymnobothrus temporalis*		LC
15	*Pnorisa squalus*		LC
16	*Gastrimargus africanus*		LC
17	*Phloeonotus humilis*		LC
18	*Grylloderes maurus*	Crickets	LC
19	*Xenogryllus eneopteroides*		LC
20	*Euryscirtus (Euryscirtus) bivittatus*		LC
21	*Phaeophilacris (Speluncacris) spectrum*		LC
22	*Arachnocephalus sp*		LC
23	*Brachytrypas membraneus*		DD
24	*Acanthoplus discoidalis*		LC
23	*Danaus chrysippus*	African monarch	LC
24	*Leptotes pirithous*	Common blue	LC
25	*Belenois aurota*	Brown-veined white	LC
26	*Colotis danae*	Scarlet tip	LC
27	*Nephila senegalensis*	Banded legged golden orb-web spider	LC
28	*Family: Ageleni*	Nursery web spider	LC
29	*Meloidae*	Blister beetles	LC
30	*Apis mellifera*	Honey bees	DD
31	*Microtermes goliath*	Termites	DD
32	*Trithemis kirbyi*	Dragon fly	LC
33	*Julida julida*	Diplopod	DD
34	*Trichonephilia clavipes*	Spider	LC
35	*Acraea eponina*	Butterfly	LC
36	*Madateuchus viettei*	Dung beetle	DD
37	*Julus terrestris*	Millipedes	DD
38	*Caelifera*	Grasshopper	DD
39	*Eurema brigitta,*	Butterflies	LC
40	*Carabidea*	Beetles	DD

No.	Scientific Name	Common Name	IUCN Status
41	*Dorylus helveolus*	Ants	DD
42	*Belonogastar junceus*	Wasps	DD
43	*Musca domestica*	House fly	DD
45	*Halyomorpha halys*	Stink bug	DD
46	*Chinavia hilaris*	Green stink bug	DD
48	*Achatina fulica*	African giant snail	LC
49	*Latrodectus renivulvatus*	Black button spiders	LC
50	*Lumbricus terrestris*	Common earth worm	LC
51	*Parabuthus transvaalicus*	Thick tailed scorpion	LC
52	*Parabuthus granulatus*	Granulated thick tailed scorpion	LC

Aquatic Survey Results

Habitats
Damming of the river has resulted in creation of 3 sub-habitats (Table 4-12):

Table 0-22: Aquatic habitats

Habitat Type	Sub-Habitats	Characteristics
River	Upstream	A deep stream. Banks lined with vegetation that appears to be in pristine state.
	Reservoir	Some sections of the reservoir covered with some pond weed. At the weir, water flows over onto downstream. The riparian zone cleared of indigenous vegetation.
	Downstream	A shallow, slow flowing seasonal stream, interjected with rocks and aquatic plants in places.

Modifications have occurred within components of the reservoir and downstream. The upstream environment, is unmodified though (table 4-13 through to table 4-18). In the downstream environment, large modifications have taken place (table 4-17 & table 4-18). This is due to inadequate environmental flows downstream. The downstream environments are usually highly dependent on the sediment dynamic that can be perturbated due to change in the water flow, for instance, presence of a weir. The whole system (upstream, reservoir, downstream), has been moderately modified, considering that it has an average ranking of 73 (table 3-6). Though, the downstream section is considered to have been largely modified. Chikowa Dam, on a non-perennial river, allows for ecological flows upstream and downstream, which are mostly significant during and right after the rain season (Appendix 9). For instance, according to the community, the catfish species have been reported to swim upstream opposite the direction of flow over the spillway into the reservoir. Alterations to the spillway height might affect these migrations.

Table 0-13: The riparian assessment – Upstream

Riparian	Average score	Score
Indigenous vegetation removal	0	0
Exotic vegetation encroachment	0	0

Bank erosion	0	0
Channel modification	0	0
Water abstraction	0	0
Inundation	0	0
Flow modification	3	1.44
Water quality	3	1.56
Total Riparian	**97**	
Category A		**(Unmodified, natural)**

Table 0-14: The instream assessment - Upstream

Instream	Average score	Score
Water abstraction	3	1.68
Flow modification	3	1.56
Bed modification	0	0
Channel modification	0	0
Water quality	3	1.68
Inundation	0	0
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**95.11**	
Category A		**A (Unmodified, natural)**

Table 0-23: The instream assessment - reservoir

Instream	Average score	Score
Water abstraction	0	0
Flow modification	18	9.36
Bed modification	8	4.16
Channel modification	20	10.4
Water quality	3	1.68
Inundation	20	8
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**66.4**	
Category C		**(moderately modified)**

Table 0-24: The riparian assessment - reservoir

Riparian	Average score	Score
Indigenous vegetation removal	20	9.6
Exotic vegetation encroachment	0	0
Bank erosion	3	1.68
Channel modification	20	9.6
Water abstraction	0	0
Inundation	0	0

Flow modification	3	1.44
Water quality	0	0
Total Riparian	**77.68**	
Category C		**(Moderately modified)**

Table 0-25: The instream assessment - downstream

Instream	**Average score**	**Score**
Water abstraction	3	1.68
Flow modification	23	11.96
Bed modification	23	11.96
Channel modification	23	11.96
Inundation	23	11.96
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**50.48**	
Category D		**(Largely modified)**

Table 0-26: The riparian assessment for - downstream

Riparian	**Average score**	**Score**
Indigenous vegetation removal	8	3.84
Exotic vegetation encroachment	0	0
Bank erosion	23	12.88
Channel modification	23	11.04
Water abstraction	3	1.56
Inundation	3	1.32
Flow modification	23	11.04
Total Riparian	**54.48**	
Category D		**(Largely modified)**

Water Quality

Good water quality is indicative of a suitable environment for various life forms and thus critical as regards to sustainability. During this study, in- situ measurements pertaining to water quality included pH, dissolved oxygen, water transparency (turbidity) and temperature. Values of these parameters obtained in-situ are shown (table 4-19). Laboratory results for pH and conductivity are included in Table 4-19 in brackets. Other laboratory results are shown in Appendix 6. A comparison of the monitoring values with reference values (Table 4-19), indicates the following:

- Dissolved oxygen, all sampling stations with an exception of at the weir and upstream, registered values within normal range.
- pH and temperature values obtained across all stations fall within normal range.
- Conductivity, the range of readings obtained across the sampled stations was between 188-195 (ms/m). These values lie within the recommended range (table 4-19). Conductivity is a measure of dissolved ions which are crucial for the ecosystem functioning. A low value of conductivity is

indicative of less dissolved ions and the converse is true. Conductivity is useful as a general measure of water quality. Each water body tends to have a certain range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes noted in conductivity could then be an indicator that a discharge or some other source of pollution has entered the aquatic resource.

- Values for water transparency at all the stations are within the normal range. This augurs well with respect to primary production (Tanebe et al, 2019), considering that light easily penetrates the water surface.

Table 0-19: Water Quality . reference values adopted from Svobodova, Z and Machov, J. (1993). Water quality and fish health. FAO manual.

Sampling point	DO (mg/L)	Temp (°C)	pH	Conductivity (µS/cm)	Transparency/Turbidity (cm)
Reference values	**5-7.5**	**25-30**	**6.5-8.5**	**150-500**	**25-60**
Downstream	5.76	25.0	7.46 (6.74)	195 (222)	41
At the weir	7.92	25.6	7.42 (6.87)	194 (222)	35
Midpoint of the dam	7.2	28.2	7.41 (7.05)	188 (230)	39
Point where river enters dam	5.76	25.8	7.46(6.72)	195 (230)	41
Upstream	7.92	25	7.67 (6.73)	189 (228)	30

Results arising from analyzing water samples show very small quantities of ammonia, nitrates and phosphates across all sampled points except at the dam wall (Appendix 6), where ammonia and phosphates appear in heightened levels. Suffice to mention that these are major constituents of fertilizers used in Zambia. Since no agricultural activities are visible within the vicinity of the dam, the high levels of ammonia and phosphate could be attributed to natural sources, viz-a-viz breakdown of organic matter and natural decomposition of rocks/minerals respectively by the dam wall. These chemicals in the long term have potential to trigger an algae bloom which could be detrimental to the ecosystem.

In the water samples analyzed by the Department of Fisheries, 9 phytoplanktons and 18 zooplanktons (Appendix 7) were identified. The former, form the base of food chain in aquatic system as they act as energy transducers and convert the solar energy into chemical energy of food. The latter, transport this food energy to the higher trophic levels and thus provides a link between energy producers and the consumers. Generally, planktons are important biological indicators of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes.

Fish Survey

Table 0-20: Fish species captured and their attributes

Family	Species	Total weight in (g) captured	Relative abundance (%)	IUCN status	Migratory species (Yes/No)
Clariidae	*Blunttooth catfish*	**1345**	**31.29**	**LC**	No

	(Clarias ngamensis)				
	Sharptooth catfish (Clarias gariepinus)	**825**	**19.19**	**LC**	No
Cyprinidae	*Redeye Labeo (Labeo cylindricus)*	**385**	**8.96**	**LC**	No
Mormyridae	*Bulldog (Marcusenius macrolepidotus)*	**50**	**1.16**	**LC**	No
Schilbeidae	*Butter catfish (Schilbe intermedius)*	**120**	**2.79**	**LC**	No
Cichlidae	*Greenheaded Tilapia (Oreochromis Machrochir)*	**290**	**6.75**	**VU**	**No**
	Three spotted tilapia (Oreochromis andersonii)	**733**	**17.05**	**VU**	**No**
	Redbreast tilapia (Coptodon rendalli)	**65**	**1.15**	**LC**	**No**
	Cross (Oreochromis machrochir & Oreochromis andersonii	485	**11.28**	**N/A**	**N/A**
	TOTAL	4298	**100**		

In total, nine species were captured during experimental fishing at Chikowa, belonging to 5 families, namely *cichlidae, cyprinidae*, clariidae, *schilbeidae* and mormyridae (Table 4-20, Figure 4-6). The CpuE was 0.3kg/100 m net / hour. During interviews with the dam management committee, presence of other fish species in the dam, was brought to light. These included *Barbus* sp, LC Synodontis *sp*. LC and *Nkupe (Distichodus mossambicus)* DD. All the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Butter catfish *(Schilbe intermedius)*

Red breasted tilapia (*Coptodon rendalli*)

Sharptooth catfish (Clarias gariepinus)

Redeye labeo *(Labeo cylindricus)*

Figure 0-11: Pictures of some fish species captured during fish survey

In Zambia, *Oreochromis andersonii* occurs in the upper Zambezi, as well as the Kafue, occasionally also recorded from the Middle Zambezi (Skelton 2001). Insufficient data are available on the apparent declines in abundance, but anecdotal evidence suggests a major decline in stocks on the Barotse floodplain since the 1960s as a result of heavy fishing pressure (IUCN, 2021). The rapid spread of alien *O. niloticus* especially through the Kafue system has also been noted as a threat to this species (IUCN, 2021, Tweddle et al. 2004). With respect to its biology and ecology, adults of *O. andersonii* are found mainly in deeper pools and main river channels. Juveniles and sub-adults are found in a variety of habitats in rivers and floodplain lagoons, large open swamps, and, more rarely small tributaries of the rivers. Feeds on detritus, diatoms and zooplankton. Males excavate large, saucer-shaped nests, females mouth brood the eggs and fry. Multiple broods are raised during the warmer months (IUCN, 2021). Lives for up to 11 years (IUCN, 2021). At Chikowa Dam, upon enhancing dam integrity via rehabilitation, population of this species likely to increase. However, a projected upscale in fishing, if not regulated could harm this species.

Green-headed tilapia (Oreochromis *machrochir*) is a common and widespread species in Zambia. Its presence has been registered at Upper Zambezi, Kafue River, Lake Bangweulu as well as Chambishi river (IUCN, 2021). Found in quiet waters along river margins and backwaters, floodplains and impoundments (Skelton, 2001, Tweddle et al., 2004). It feeds mainly on microscopic foods such as algae, especially diatoms and detritus. Females mouth brood eggs and fry. Breeds in summer, nests grounded into arenas (IUCN, 2021). This species is threatened by alien species Nile Tilapia (*Oreochromis niloticus)* and is displaced when the two species occur together (IUCN, 2021). Just like *O. andersonii,* Green-headed tilapia (Oreochromis *machrochir*) at Chikowa likely to benefit greatly in terms of population growth on account of a better dam upon rehabilitation works. Also, the fact that threats from Nile Tilapia (*Oreochromis niloticus)* are absent, will contribute to spurring its growth in population. Suffice to mention though, that fishing as it increases, with a burgeoning human population around the dam, will be the main threat as regards how the species increases in population.

Invertebrates

A total of 9 macroinvertebrates were encountered in the field (Table 4-21). Some of the macroinvertebrates are key by being links in the food web between the producers and higher consumers such as fish.

Table 0-21: Invertebrates

English name	Scientific name	IUCN status
Dragon flies	*Anisoptera sp.*	DD
Horse fly	*Tabanus bovinus*	DD
Mosquito	*Aedes sp*	DD
Whirligig beetles	*Gyrinus natator*	DD
water boatman	*Corixidae sp.*	DD
water strider	*Gerridae sp*	DD
Mayfly	*Baetidae*	DD
Crab	*Potamonautidae sp*	DD
Snails	*Gastropoda sp*	DD

Aquatic flora

Eight species of aquatic flora were encountered during this assessment (Table 4-22). Aquatic flora is critical to the health of an ecosystem. It provides food, shelter and breeding sites for some fauna (Tsugi & Muzungilwa, 2002). *Tena tena* has formed a blanket-like thicket covering a section of the mid area of the reservoir (Fig. 4-8). If it continues with this trend, its likely a significant part of the reservoir could be affected. This could have far-reaching consequences on the whole ecosystem.

Table 0-22: Aquatic flora

English name/Local name	Botanical name	IUCN STATUS
Bullrush	*Typha angustifolia*	LC
Water primrose	*Ludwigia peploides*	LC
Tena tena (Local name)	*Pistia stratiotes.*	LC
Reeds	*Phragmites sp.*	LC

Smartweed	*Polygonum pensylvanicum*	LC
Cattail	*Typha latifolia*	LC
African star grass		LC
Nembaule (Local name)		

Fig 4-8: *Tena tena* covering part of mid-section of the reservoir

Evaluation of Impact significance

Using the criteria explained in subsection 3.1.3 of this report, the potential impacts that the proposed projects may have on the biodiversity in the area were evaluated and reported in Table 4-16. The unmitigated values are shown below. It is anticipated that the impact significance will be lower once the proposed mitigation measures in the BMP are applied.

Table 0-27: Impact evaluation and reporting

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
1.0. TERRESTRIAL											
Site Preparation and Construction Phase											
Impacts on Terrestrial Biodiversity											
Flora clearing for site preparation and access roads	Loss of Indigenous flora species/reduction in population i.e. stocks per area	Paving way or creation of space for access roads, setting up of construction camp as well as excavation of laterite (borrow pits) for construction works will certainly demand for clearing of vegetation in certain locations of the site	Rare	Certain	Local	Long	Low	Negative	Direct	Medium	Medium
	Habitat fragmentation	Creation and/or rehabilitation of access roads, construction camp and setting up of working or operational areas will further fragment the already fragmented habitats on site	Rare	Likely	Local	Long	Low	Negative	Indirect	Low	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Loss of habitats and associated fauna	Vegetation clearing will result in loss of habitats for the fauna observed on site - birds, insects (invertebrates), mammals (mainly hares and mice) as while as reptiles (snakes and lizards) on site. Birds may also lose nesting trees. If not checked, this may consequently result in loss of fauna.	Rare	Certain	Local	Long	Low	Negative	Direct	Medium	Medium
Heightened noise levels	Disruption of fauna activities	Noise from heavy construction machinery (vehicles), increased number of people on site and general workings on site will likely unsettle or disturb the fauna. Sleeping schedules, feeding movements and resting time may be affected in this regard.	Rare	Likely	Local	Medium	Low	Negative	Direct	Low	Low
Vehicle-fauna collisions	Injury or mortality of fauna	Increased vehicular movement in the sub-project area of influence may potentially result in collisions with fauna on site that is not accustomed to this situation. In case of this occurrence, this can result in injury or mortality.	Rare	Likely	Local	Medium	Medium	Negative	Direct	Medium	Medium
Hunting and trading in wildlife	Reduced fauna population	If in-migration occurs as a result of project implementation it will likely increase demand for food including game meat. This may increase the risk of hunting wild game for meat. For the same reason, trading in wildlife may increase	Rare	Unlikely	Provincial	Short	Low	Negative	Indirect	Low	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increased demand for medicinal use of flora and fauna as a result of In-migration	Increased exploitation of medicinal biodiversity in the project area of influence	Because of the increased population resulting from in-migration, the demand for medicines from flora and fauna is also likely to increase. This is likely to be the case because of lack of hospitals and clinics in the project area of influence	Rare	Likely	Local	Short	Low	Negative	Indirect	Low	Low
Increased demand for firewood or wood based fuels	Debarking Cutting down of trees	Pressure on trees will increase with the increase in demand for firewood and wood based fuels which will be as a result of increased number of people in the area (in-migration).	Rare	Likely	Local	Short	Low	Negative	Indirect	Low	Low
Impacts on Terrestrial Habitats											
Destruction of existing habitats on site	Fragmentation and depletion of habitats	Project activities such as setting up of camp site, creation of access roads, creation of working area and claiming of laterite from borrow pits will contribute to the fragmentation and depletion of habitats on site.	Rare	Likely	Local	Long	Low	Negative	Direct	Low	Low
	Reduced value or integrity of habitats	Mismanagement of project activities can result in contamination of habitats. These activities include handling of hydrocarbons (fuel, oils and hydraulic fluids), industrial and domestic waste can also contribute to this impact. If not properly handled, hydrocarbons and different streams of waste can further reduce the value of habitats on site.	Rare	Likely	Local	Medium	Medium	Negative	Direct/Indirect	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Introduction of Invasive species and pathogens	There is a possibility that Invasive plants and seeds may be accidentally or intentionally introduced into the project area of influence by workers through clothing, vehicular movements, and as ornamental plants. In case of fauna, introduction may be mainly through pets.	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low
Impacts on Biophysical Environment											
Increased risk of fire occurrences	Reduced habitats/ecosystems value and increased risk of injury or death of flora and fauna	The presence of humans on site carries with it the risk of bush/forest fires as a result of cooking, smoking, arson as well as accidents. The results fires can negatively affect both habitats and biodiversity species on site.	Rare	likely	Local	Medium	Medium	Negative	Indirect	Medium	Medium
Air, Water and Soil pollution	Contamination of the biophysical environment	Biophysical environment contamination may arise from: • Mismanagement of domestic and industrial waste on site;	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Injury or mortality of fauna	• Spillages and leakages of chemicals on site such as fuels, oils and other liquid and solid based substances • Exhaust emissions from machinery • Dust generation from movement of machinery, excavations and related project activities These activities can possibly reduce the value of the habitats as well as injure or even kill both flora and fauna species on site	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low
Operations Phase											
Dam Failure											
Risk of dam failure	Mortality or injury to flora and fauna	Dams always have an inherent risk of wall collapse. Even in the case of Chikowa Dam, this may happen. In case of occurrence this may kill or injure flora and fauna downstream.	Rare	Unlikely	Regional	Long	High	Negative	Direct	High	Medium
2.0. Aquatic											
Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas	Clearing vegetation	Creation of access roads, setting up of construction camp, clearing dam area of vegetation during rehabilitation, could contribute to an increase of siltation within aquatic habitats	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increase in water pollution	Stresses flora, fauna and habitats	Some materials used during site preparation and construction could pollute the water in the dam. During construction, there will be an assortment of machinery operating, and an increased number of people. Ultimately, this could increase noise levels (pollution) in the area. This could stress some lifeforms	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Increased fishing pressure	Reduced fish population	Project likely to increase number of people in the area. This could ultimately translate into increased demand for food items such as fish.	Rare	Unlikely	Provincial	Medium	Low	Negative	Indirect	Medium	Low
Increased demand for water	Compromised aquatic habitat	Construction is a water demanding task. Further, the construction workers will need water for personal use.	Rare	Unlike ly	local	Mediu	Low	Negati ve	Indire	Mediu	Low
Hazardous waste contaminating habitats	Loss of flora and fauna, degraded habitats	Some by- products of construction work, could be hazardous. And if they are disposed in water, unintentionally r intentionally, they could degrade habitats, cause diseases and in some cases mortality to fauna and flora.	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Operations Phase											
Increase in populations of flora, fauna including species of conservation concern	Populations of flora & fauna to increase, and habitats enhanced	When the dam is fixed, it will operate efficiently. Consequently, habitat integrity is enhanced. This could ultimately impact positively on the populations of flora and fauna.	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Increase in weed coverage- Tena tena has formed a blanket-like thicket within mid area of the reservoir	It could eventually limit amount of light penetrating the surface of the water in the reservoir	When the dam is rehabilitated, and functioning better, this could facilitate further spread of this aquatic plant.	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Habitat pressure caused by the dam	Over grazing, irrigation and fishing activities around the dam	When the dam is repaired, it will operate efficiently. This could trigger an increase in fishing, irrigation and livestock activities around the dam causing an increase in grazing pressure around the dam, irrigation area and fishing activities affecting vegetation, causing siltation which will affect the dam	Frequency	Certain	Local	Medium	Medium	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Enhancement of environmental flows	The downstream flows shall continue during the runoff season in relation to the design	The flows will be maintained as per the design and storage ratios. The habitats protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species of conservation shall be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Longterm	Medium	Positive	Direct	Medium	Medium
Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam shall ensure increased habitat integrity and populations of aquatic biodiversity.	Frequent	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Loss of species of conservation concern	Overfishing	Overfishing and use of unsustainable fishing methods can deprive the waters of fauna species such as species of conservation, plankton and invertebrates.	Rare	Unlikely	Local	Medium	Medium	Negative	Direct	Medium	Medium
Increase in water pollution	Chemicals used for agriculture and loose soils from fields may run into the waters	Increased chemical pollution from agriculture practices which can lead to algae growth and eutrophication. Sedimentation due to soil erosion resulting from farmlands and agriculture land tilling methods around the dam, upstream and downstream.	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Settlements /infrastructure downstream may be inundated and damaged	Loss of flora and fauna, infrastructure. And unfortunately, there could loss of human lives	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir.	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low
Removal of weir could lead to severe losses of water, fish, other lifeforms from the dam compromising livelihoods especially for those using the dam for fishing and agriculture	Loss of flora and fauna, infrastructure. And unfortunately, there could loss of human lives	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir.	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low

Impacts summary

Terrestrial Biodiversity Environment

Negative Impacts during rehabilitation works include:

- Vegetation clearing for site preparations
- Loss of fauna due to vegetation clearing and activities on the site
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

Positive Impacts during operation and maintenance include:

- Increased water availability for fauna growth

Negative Impacts during operation and maintenance include:

- Vegetation clearing due to anthropogenic activities
- Loss of fauna due to vegetation clearing
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

Aquatic Biodiversity Environment

Positive Impacts during rehabilitation works include:

- Increased ecological integrity leading to increase in the life forms populations in the dam

Negative Impacts during rehabilitation works

- Compromised aquatic habitats and breeding areas for fauna through vegetation clearing
- Pollution of water which stresses flora, fauna and habitats
- Increased demand for water compromising aquatic habitat
- Loss of species of conservation concern due to construction works and illegal fishing methods by the contractor

Positive impacts during operation and maintenance include:

- Increase in populations of flora, fauna; when habitat integrity is enhanced
- Maintained environmental flows downstream and protected upstream, downstream dambos, and the dam habitats- The downstream flows shall continue during the runoff season in relation to the design

Negative impacts during operation and maintenance include:

- Compromised aquatic habitats for fauna due to overgrazing and increased vegetation clearing
- Pollution and sedimentation of water due to increased cattle use of the dam, which may stress flora, fauna and habitats in the dam and downstream

- Increased fishing pressure which may reduce fish populations
- Loss of species of conservation value due to overfishing and unsustainable fishing methods
- In case of maintenance failure and dam failure, downstream habitats may be inundated and damaged with loss of flora and fauna.

Impacts concluding statement

Chikowa Dam provides a permanent water body on the Kasenengwa River, which is a small seasonal tributary of the Luangwa in the Zambezi Basin. Situated towards the upper end of the catchment, the dam spills regularly in the wet season. Terrestrial and downstream aquatic habitats in the dam's area of influence have been significantly impacted over the years (decades) by subsistence cultivation and grazing of cattle. The dam itself has had little negative impact on the biodiversity of the stream and downstream river system. There are no aquatic or terrestrial species of conservation of significance that have been affected by the regulation of flow nor that are expected to be affected. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. The major threat to these two species, the Nile tilapia, which has been introduced into the Kafue River system, does not appear to be present near the dam's impoundment area which is in the Luangwa River system. While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam – there is no significant increase in downstream erosion caused by the stream that could be attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be settlements and the practice of farming. General habitat degradation in the surrounding areas is not attributed to the dam's impoundment.

Since this is an existing dam, it is likely that the remedial works may not encourage additional cultivation and will not change the current patterns of stock use that have existed since construction. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by managing overstocking and discouraging cultivation in the seasonally wet dambos and riverine areas. This will be the responsibility of the nominated DMC, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources shall taught to the DMC and farmers. Together with control of overfishing, better catchment management will assist in stabilizing the available aquatic resource for sustainable use by local communities.

BIODIVERSITY MANAGEMENT PLAN (BMP)

This site specific BMP for Chikowa Dam has been developed in this section and Appendix 8 –Habitat management to guide management of biodiversity in the subproject area of influence. It is based on the ecological assessment detailed in the preceding sections of this report. The assessment identified the ecosystems (habitats) as well as the flora and fauna present in the project area of influence. It also gives information on the extent of potential impacts anticipated. Information gathered in the ecological assessment was used for the preparation of this BMP.

Objectives of the BMP

The main objectives of the BMP are to provide a structure to manage impacts according to the mitigation hierarchy, and to provide a roadmap for the implementers of the mitigation measures.

Specific objectives:

- Compliance with national regulations and international guidelines and/or standards regarding biodiversity management;
- Address of biodiversity risks identified through an ecological assessment of the project area of influence; and
- Remediation of impacts of the initial works on the dam

Scope of the BMP

This BMP only covers the defined area of influence for Chikowa Dam. Further, its focus is on the management of potential impacts of the proposed dam works as listed in subsection 1.4 of this report.

Table 0-28: Biodiversity Management Plan BMP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
1.0. SITE PREPARATION AND CONSTRUCTION PHASE						
1.1. TERRESTRIAL						
Areas or Habitats of Special Interest – Forested Area on the South						
1.1.1	Loss of areas/habitats of interest	To avoid or prevent the destruction of area of interest – Forested area South East of Chikowa Dam	The Contractor on site shall not undertake any construction activities, clear or cut any trees within the forested area that is on the immediate south east Chikowa Dam. This area provides favorable habitats for observed fauna within the project site.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			Contractor employees, DMC and community members will be sensitized on the location and importance of preserving the areas of interest marked for conservation with emphasis on the forested area on the immediate South East of Chikowa Dam.	Beginning of construction works	On-going	UNOPS and DMC
Fauna Species of Interest						
1.1.2	Loss of fauna species of interest	To avoid or prevent the Loss of fauna species of interest listed in Table 4-7 of this document	Contractor employees, DMC and community members will be sensitized on the seasonal or migratory presence of animals listed in Table 4-7. Rules will be laid down that will include: • No killing or hunting of fauna in the subproject area of influence including the listed animals in Table 4-7;	Beginning of construction works	On-going	UNOPS and DMC

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			• No buying or selling of game meat; and • Mandatory reporting of the sighting of the listed animals to the contractor on site, DMC and UNOPS staff (when available)			
			UNOPS shall train the DMC members, selected influential community members and contractor on management of handling of Human-Animal conflicts as a way of preserving the seasonally available or migratory animal species listed in Table 4-7	Beginning of construction works	End of constructio n works	UNOPS and DMC
Indigenous Flora						
1.1.3	Flora clearing for site preparation and access roads	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor shall ensure that vegetation clearing is subject to approval by the Project management team or Manager on site to avoid unnecessary flora loss. Riverine buffer zone shall not be disturbed (Appendix 8- dam and dambo management). Flora management shall be included in the sites' method statements (refer to ESMP).	Beginning of construction works	End of constructio n works	Contractor Supervision- UNOPS
			The contractorcontractor shall use old site access roads as they are still open. Only in instances where existing access roads need widening will the necessary clearing be done. This measure will ensure avoidance of unnecessary vegetation clearing. Roads shall not be close to riparian	Mobilization	End of constructio n works	Contractor Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			buffer zones/ water bodies (Appendix 8- dam and dambo management).			
			Whenever possible e.g. at camp sites, the contractorcontractor shall ensure that trees will be cut at knee height to promote coppicing at the end of the project	Mobilization	End of construction works	Contractor Supervision- UNOPS
		Avoid use of indigenous wood/timber	The contractor shall not use indigenous timber/wood for construction and related works on site as this will not be allowed. When timber is required, it will be procured from licensed pine and/or eucalyptus dealers	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractorcontractor shall sensitize and discourage its employees from using Charcoal and firewood on site. Instead alternatives such as gas stoves will be promoted	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
1.1.4	Habitat loss by the introduction of Invasive flora species	Avoid and/or prevent the introduction of invasive species	The contractorcontractor shall not allow the planting or seeding of alien or foreign flora species on site. To this effect, all employees on site will be sensitized.	Beginning of construction works	Project closure	Supervision- UNOPS
			The contractorcontractor shall develop and implement an alien invasive species prevention protocol to prevent the introduction and transfer of invasive plant species. This will include the avoidance of affected areas by staff and vehicles where possible and wash down procedures	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			for Project vehicles that are suspected to have been in areas infested with invasive species.			
			The contractor shall ensure that only non-invasive local plant species are used for revegetation efforts under the project	Beginning of construction works	Project closure	Contractor Supervision- UNOPS
		To control the spread of exotic Milk Weed, *Helianthus tuberosus* and other invasive weed species on site	UNOPS and Forestry shall train the DMC who shall and implement (the programme for uprooting the Milk weed which has infested the sub-project area of influence	Beginning of construction works	Project closure	UNOPS and DMC
Fauna						
1.1.5	Injury and/or loss of fauna	To preserve fauna in and around the project site	The contractor shall not allow or permit hunting or killing of any wildlife on site. Hunting will constitute a serious breach of contract and will be reported to relevant authorities. Fauna management shall be included in the sites' method statements (refer to ESMP).	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS
			The contractorcontractor shall avoid clearing/cutting down of trees in riparian habitats and on the edges of dam and dambos. This is because trees in the riparian habitats are mainly used for nesting by indigenous birds species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractorcontractor shall ensure that active bird nests are not damaged during site preparation and construction activities. As far as	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			possible tree and scrub clearance will not be undertaken during the breeding season (March to August inclusive). Should clearance during this time be necessary a preclearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the Biodiversity Specialists.			
1.1.6	Injury or mortality of fauna due to accidents	Avoid collisions of vehicles with fauna on site	The contractorcontractor shall • Provide driver awareness and training; • Enforce speed limits; • Restrict vehicle and machinery operation to daylight hours to avoid collisions with nocturnal and crepuscular fauna • Report any collision, document species affected and area of occurrence for record keeping and development of better abatement strategies.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.7	Increased incidences of disturbance or disruption fauna due to works	To avoid disturbance of nocturnal fauna on site	The contractorcontractor shall restrict construction and related works to day time (6AM – 6PM). Night working and the use of excessive artificial lighting will not be permitted to avoid adverse impacts on nocturnal and crepuscular fauna observed on site. Strong lightning sources may also disturb	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			migration or night movement of certain species.			
			When there is need to use lighting at night, the contractor shall ensure that Non-UV sources of lighting are utilized so as not to attract the nocturnal insects and thus other fauna that feed on them. This will help to avoid the risk of predation competition and high mortality of insects.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To avoid disturbance of fauna on site during day time	To reduce noise on site, the contractor shall: • Service all equipment and vehicles in line with manufacturers specifications; • Not allow idling of vehicles on site and unnecessary honking; • Sensitize employees on the need to minimize noise on site	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.8	Loss of native species due to the introduction of invasive fauna species into the project area of influence project	To avoid the introduction alien fauna species	The contractor shall: • Develop project staff conduct guidelines that would include the interdiction of transporting live or dead animals, plants or seeds in project vehicles; • Inspect company vehicles for illegal fauna and flora products before access to site is granted; • Provide project staff with a hygiene and vaccination campaign; • Train staff to recognize key invasive species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
Habitats						
1.1.9	Increased habitat fragmentation	Avoid further fragmentation of habitats	The contractor shall not create new access roads on site. Instead old ones will be rehabilitated for continued use	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
	Reduced integrity, and Extent of habitats	To maintain the natural extent of the dambos in project	The contractorcontractor shall not carry out any construction and related project activities within dambos and fruit forests on site.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor shall set the construction camp site at least 100m from the nearest dambo and the riverine. It is strongly recommended that the old camp site area be utilized even this time around	Beginning of construction works	Project Closure	UNOPS and DMC
			The DMC and UNOPS shall ensure that there are no agricultural activities within identified dambos, fruit forests and along the riverine	Project mobilization	On-going	Traditional Authority and DMC
1.1.10	Loss of integrity of the terrestrial habitats	To preserve the integrity of the vegetation on site	The contractor shall carry out construction works such as cement mixing in already disturbed areas. Preferably those areas utilized during the initial construction works should be used whenever possible	Beginning of construction works	End of constructio n works	Contractor Supervision - UNOPS
			To minimise risk of pollution, the contractor shall: • Store all hydrocarbons including fuels, used oils, new and used oil filters and grease in designated places fitted with spillage	Beginning of construction works	End of constructio n works	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			protection mechanisms such as bunding and impermeable flooring • Train employees handling these materials in material handling and spill prevention			
1.1.11	Increased fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor shall not allow bush burning and or open fires forested, riparian buffer zone or vegetated areas. Employees will be sensitised to this effect.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			The contractor shall sensitise employees on the dangers of forest fires to both humans and the ecosystem and how to avoid them.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
Training or Capacity Building						
1.1.12	Poor adherence to requirements in the BMP	To capacity build the contractor's employees in BMP implementation	The contractor shall sensitize or train all its key employees on the importance of this BMP, its contents and how best to implement it and their roles.	Project mobilization	Project closure	UNOPS
		To sensitize or train employees and local community members on Biodiversity management	UNOPS shall offer biodiversity management training to contractor employees and the locals. This training will include sensitization on: • flora and fauna present in the area • Importance of flora and fauna present within in the project site • Contents of this BMP, its implementation and roles of community and employees	Project mobilization	Project closure	UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			• Sustainable management of the water dam on site • Identification and Handling of key invasive species such as Milk weed and *Helianthus tuberosus* • Roles of community members on biodiversity management			
1.2. AQUATIC (SITE PREPARATION AND CONSTRUCTION PHASE)						
1.2.1	Increase in pollution and siltation of water	To ensure that pollution, soil loosening and siltation is controlled	The contractor shall carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste shall be disposed of in a matter prescribed by ZEMA and the local town council. The contractor shall maintain buffer zones (Appendix 8- dam/ dambo management).	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
1.2.2	Increased demand for water	To ensure prudent usage of water throughout construction phase and thereafter	The contractor shall ensure that construction water shall not compromise aquatic biodiversity requirements and environment.	Project Mobilization	On-going	• Contractor • Supervision UNOPS • DMC • Traditional leaders • Department of water Affairs
1.2.3	Pollution of soils and water by hazardous waste products	To ensure that these are handled and disposed of in a manner that does not cause harm to habitat and its constituents	The contractor has to adhere to best practices recommended by ZEMA when handling such materials. The waste shall be kept in bunded facilities. The final handlers shall be licensed waste management handler.	Project mobilization	End of construction works	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			Hydrocarbons shall not be allowed in water. Any spill shall be handled using spill kits and isolation methods. These shall be disposed of in a matter prescribed by ZEMA.			
1.2.4	Uncontrolled spread of *Tena tena*	Limit spread of Tena *tena*	DMC working in collaboration with other stakeholders, shall physically remove *Tena tena*	Operations phase of the project	On-going	DMC Supervision -UNOPS
2.0. OPERATIONS PHASE						
2.1. TERRESTRIAL						
Flora						
2.1.1	Increase in vegetation restoration	To revegetate the area in the vicinity of the dam To promote catchment management (Appendix 8)	DMC and IDSP will initiate revegetation exercise to restore flora in cleared areas on the peripheral of the dam within 500m. Exposed areas will be tilled to a depth of 20cm and top soiled were possible. The area will be seeded with indigenous trees and grass species. This will be done between November and February during the rainy season (Appendix 8- dam and dambo management). The Ministry of Agriculture, Forestry and Fisheries shall implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS Forestry, WARMA, Agriculture, Fisheries etc.

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.1.2	Conservation of areas of interest	To preserve the marked areas of interest.	After handover of the dam, the DMCwill continue to preserve/manage the marked areas as itemized in part 1.1.1 of this BMP.	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS
Fauna						
2.1.2	Increase in conservation/management of fauna on site	To conserve/manage fauna within the dam's area of influence	DMC in collaboration of the Local authorities will continue implementing fauna management actions during the operation phase of the dam. These measures will include: • Prohibition of hunting • Prohibition of tree cutting within the vicinity of the dam • Prohibition of agricultural activities within dambos and sensitive habitats within the project area of influence • Continued sensitization on the benefits of flora and fauna conservation	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS
Rehabilitation of Legacy and New Borrow Pits						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.1.3	Promotion of habitats by the rehabilitation of legacy and present borrow sites	To rehabilitate both New and Old Borrow Pits on site	At the end of construction works (during operation phase of the dam), the contractor shall rehabilitate both new and old borrow pits. This will be done by: • Re-sloping the edges of the pits to a gradient equal to or less than 45^0; • Creating a drainage system so has to avoid stagnation of water at the borrow pit sites; and • Tilling the area to a depth of 30cm and revegetating with indigenous tree species and grass seeds	Operations Phase of the project	Completion of rehabilitation works	Contractor and UNOPS Supervision - UNOPS
Training (Capacity Building)						
2.1.4	poor understanding of the content of the BMP by the Dam Management Committee	To train or sensitize DMC and local communities	Before handing over of the dam, UNOPS shall sensitize and train the DMC and key members of the local communities such as traditional authorities, and selected influential individuals on: • Dam management and safety; • Emergency Preparedness in an event of dam failure • Continued biodiversity conservation; • Continued implementation of this BMP principles; and their roles in all this.	Project Operation Phase	Completion of training	UNOPS
Invasive Species						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.1.5	Increase in invasive fauna and flora species management	To Prevent colonization of project area of influence by invasive species	UNOPS and forestry shall train the DMC and selected local community members on the implementation of invasive species management Communities shall not introduce invasive species. Any spotted invasive species shall be controlled by the DMC from the start.	Project Operation Phase	Completion of training	DMC
Demobilization						
2.1.6	Demobilization	To leave the site in the initial or better state relative to the baseline	At the end of construction works, the contractor shall • remove all equipment and structures from construction camp site; • turn over the soil on site to a depth of 20cm; • Re-slope to mimic the natural terrain; and • Re-vegetate with indigenous flora species	End of construction works	Demobilization	Contractor Supervision - UNOPS
			At the end of remedial construction works, the contractor shall rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS
2.2. AQUATIC						
2.2.1	Increased fishing pressure that could lead to a	To avoid depletion of fish population on account of	The DMC collaborating with other stakeholders (Department of Fisheries, Ministry of Livestock and fisheries, Traditional authorities,	Project mobilization	On -going	• DMC • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	reduction in fish population	heightened fishing pressure	fishers) to issue fishing passes to fishers on rotational basis. This should be informed by research as regards the standing biomass of fish at any particular time. Further, fishers should be encouraged to harvest fish by way of employing passive gears such as hooks and lines, and gillnets. Gillnets of mesh size less than 63 mm should not be allowed to avoid capturing immature fish.			• Fishers • Department Of Fisheries • Ministry of Livestock and Fisheries • Supervision UNOPS •
2.2.2	Increase in populations of flora, fauna; when habitat integrity is enhanced	Providing a conducive habitat for aquatic biodiversity	The contractor shall rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC shall be trained in proper sustainable fishing methods and dam protection. Protection of the dambos by the DMC and community by using allowed fishing methods and protecting their integrity.	End of construction works	Demobilization	• DMC IDSP
2.2.4	Maintained and improved environmental flows downstream and protected upstream, downstream dambos, and the dam habitats	To enable and promote ecological flows and protection of dambos	The UNOPS design shall ensure ecological flows are continuous during the rainy season according to the dam's storage ratio. Raising of the spillway might affect the current occurring upstream catfish migrations. The IDSP and UNOPS shall train the DMC on flow monitoring for the seasonal flows and their importance. The DMC and IDSP shall monitor flows.	End of construction works	Demobilization	• UNOPS • DMC IDSP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			DMC shall ensure protection and maintenance of. The dambos and dam shall be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion. Protecting these habitats shall ensure continuous protection of life forms and their flow during runoff seasons			
2.2.5	Increased habitat pressure caused by the dam leading to over grazing, increase in irrigation area, and fishing activities close to the dam	To reduce pressure on the area around the dam	DMC to ensure vegetation is maintained around the dam and animal feeding is away from the dam. Catchment management training programmes included in the training plan. The DMC shall not allow grazing close to the dam and vegetation shall be maintained. Preventing cattle and human activity to intervene in riparian/wetland areas would be important to avoid further degradation (Appendix 8- Dam and dambo management).	End of construction works	Demobilization	• DMC • Traditional leaders • Forestry • Fisheries • IDSP
2.2.6	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimize contamination of water and loss of biodiversity	The DMC shall take part in catchment management and protection of buffer zones (Appendix 8) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall allocate specific	End of construction works	Demobilization	• DMC • Traditional leaders • IDSP Forestry

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.			
2.2.7	Potential growth of algae in the dam and dambos/ wetlands upstream or downstream due to irrigation (use of chemicals) and from livestock droppings	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during agriculture and irrigation activities	The IDSP/ Ministry of Agriculture shall ensure that the local community are trained the best way to practice crop and animal agriculture to ensure preservation of the environment and quality of water	During project rehabilitation period	Operation phase	• Ministry of Agriculture/IDSP
2.2.8	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimize contamination of water and loss of biodiversity	The DMC shall take part in catchment management and protection of buffer zones (Appendix 8) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	• DMC • Traditional leaders • IDSP • Forestry
2.2.10	Overexploitation of fish resources which reduce fish population	To ensure that fish resources are sustainably utilized	The dam should not be open access with respect to fishing. The DMC and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with	End of construction works	On-going	• DMC • Ministry of fisheries & Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	Loss of species of conservation concern due to overfishing and introduction of invasive species		respect to who can fish, where, when and how. The DMC collaborating with the DMCand traditional leaders, Min. of Fisheries and Livestock, to ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. Controlled catching and breeding season breaks will be enforced. Fishing methods shall be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity shall be protected by sedimentation control and pollution prevention by the communities; and catchment management. The DMC and Fisheries shall not introduce invasive species on the water			•
2.2.13	Increased irrigation farming upstream close to the riparian zone Increase in irrigation activities downstream	To ensure that the integrity of the riparian zone upstream and downstream is sustained to forestall siltation of the aquatic habitats To reduce siltation	The DMC collaborating with Min. of Agriculture, Traditional leaders, Min. of Fisheries and Livestock, to ensure that no one is farming along the riverine. Those with farming plots along the same, have to be relocated/ provided with alternative pieces of land away from the riverine. Where they can continue farming.	Construction and operation phases	On-going	• DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.2.14	Increase in populations of flora, fauna; & habitat integrity enhanced	To ensure that flora, fauna and habitat are well secured	The DMC working in collaboration with other stakeholders (Ministry of Fisheries and Livestock, Ministry of Agriculture, traditional authorities, to formulate management plan to secure these resources. The plan should be reviewed time and again in tandem with changing dynamics on the ground	Project mobilization	On-going	• DMC • Ministry of fisheries and Livestock • Ministry of agriculture • Traditional authorities
2.2.15	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure, settlements/infra structure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives	To ensure that sedimentation is controlled To ensure dam functionality To promote maintenance activities post rehabilitation works	The contractor shall execute designed works with expected skill supervised by UNOPS. Afterwards, there should be regular monitoring of the dam's integrity by key stakeholders to forestall decommissioning. There will be adherence to the operations and maintenance manual by the relevant stakeholders as indicated in the manual. The stakeholders (DMC, Ministry of fisheries and Livestock, Ministry of Agriculture, Water resources development, Ministry of water, sanitation and environmental protection, Traditional leaders) should collectively invest efforts to ensure that the dam wall and other accompanying structures are always in a good condition. They shall also implement catchment management	Project mobilization	On-going	• DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders • Water resources development department •

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			activities over a period of time (Appendix 8).			

Follow-up and Monitoring

The monitoring plan for the Project was developed to ensure the proper implementation and effectiveness of mitigation measures. Parameters or indicators to be monitored have been developed by adhering to the SMART nomenclature (scientific, measurable, accountable, reliable, and time-bound).

The aims or purposes of this monitoring plan are to: observe the deviation from the baseline conditions of the observed biodiversity and environmental factors and assess the effectiveness of the impact mitigation/management interventions put in place; and prevent the occurrence of serious negative project impacts on the biodiversity and environment by facilitating timely corrective actions on project aspects and management interventions not yielding the intended results

Table 0-29: Biodiversity Monitoring Plan

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
1.0 Terrestrial						
Construction Phase						
1	Loss of vegetation cover.	To avoid where possible or limit loss of vegetation as much as is possible.	The contractor shall use already cleared areas where possible. Where there is need to clear, clear boundary or working area shall be defines and fenced off as the only defined area where vegetation clearing shall take place.	During remedial works	• Contractor	Vegetation maintained in the present condition except for defined areas as demanded by project works/accessories.
			The contractor in consultation with FD personnel shall ensure trees are cut in such a way as to promote coppicing.	During remedial works	• Contractor working with Forestry Department	Trees cut at knee height.
2	Loss of habitat	To ensure availability of diverse habitats for various forms of insects and animals.	Conduct a re-forestation program in areas that will lose vegetation cover inevitably during the rehabilitation works and also in areas that do not have much vegetation cover due to initial construction works.	At completion of remedial works.	• Contractor • Forestry Department • Dam management committee	Degraded sites artificially aided to regenerate by onset of rain following completion of works.
3	Soil degradation	To restore soil organic matter and soil micro-organisms lost due to trampling and compaction by equipment and machinery during	Restock affected areas with miombo vegetation to allow for re-colonization of the associated biodiversity.	At completion of remedial works.	• Contractor • Forestry Department • Dam management committee.	Affected areas restocked with miombo vegetation.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
		remedial measures.				
4.	Loss of soil properties needed to support terrestrial	To avoid polluting the soil with spent oil (oil from the engine) and/or fuel.	The contractor must ensure that the equipment and machinery used is in good working conditions. No fuel and oil leakages. Vehicles and other equipment should be parked and stored in designated places when not in use.	During remedial works	• Contractor • UNOPS	Affected sites restored by use of oil adsorbents, with report indicating how much was used.
5.	Rehabilitation of legacy and current sites	To ensure that all impacted sites are brought back to their near original state.	The contract will rehabilitate all impacted sites or opened up areas by providing for regeneration of vegetation in the affected areas	At the end of remedial works	• Contractor • UNOPS	Re-vegetation / Tree planting done.
6.	Poor dam management and environmenta compliance levels	To ensure compliance to various environmental parameters and knowledge of dam operations and maintenance	UNOPS shall develop a dam operation manual and selected relevant sections to capacity build in the DMC. The contractor with stakeholders shall provide trainings to the DMC and community. Guided by the supervising engineer, selected topics will be covered to sensitize the local community	At the end of remedial works and before commissioning of the dam	• UNOPS working with Ministry of Agriculture and local council	No. of trainings/sensitization meetings held
Operation phase						
1.	Loss of ecosystem services provisioning	To restore the inherent ability of the miombo woodlands to provide ecosystem	The DMC and Forestry with the catchment management Committee shall conduct	During and after rehabilitation works.	• DMC • Local traditional leadership	Reforestation of cleared areas done at the onset of the rain season following

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
		services such as NWFP*, ethnobotanic value etc.	reforestation of the impacted areas. They shall: • Promote biological diversity conservation programmes that have positive impacts on the natural ecosystems. These include bee keeping, and conservation agriculture. Additionally, promotion of NWFP (such as caterpillar, mushrooms, wild fruits etc.) through provision of ready market opportunities. This can encourage and motivate local communities to focus more on activities that are friendly to the natural ecosystem. • Conduct community awareness programmes on various issues dealing with biological diversity and ecosystem management and conservation. • Implement community based natural resource management	Monthly visits in the initial stages then quarterly after the reforested areas establish and when community structures become fully functional.	• Ministry of Agriculture • Forestry • Catchment committee	completion of rehabilitation works. Fliers for community sensitization produced not more than 3 months after completion of works. One community sensitization meeting report per quarter.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			• Catchment management (Appendix 8) DMC shall control and monitor any invasive weed infestation			
2.	Loss of flora in the stream catchment areas has the potential to degenerate water resources	To ensure continued availability of water for animal watering and vegetable gardening.	The DMC and Forestry shall protect the Kasenegwa Stream catchment area through proper management of the forest ecosystem around the area (No cutting of trees).	During and after completion of rehabilitation works.	• Contractor • Forestry Department committee. • Local traditional leadership. • DMC	Catchment area protection sensitization programme.
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds downstream	Loss of feeding and breeding grounds	The contractor shall maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	• Contractor • UNOPS • DMC • Fisheries	Loss of feeding and breeding grounds downstream
3.	Soil erosion from opened up areas causing siltation in the reservoir and parts of upstream and downstream	To arrest soil erosion from taking place which smother sediments that provide food nutrients for aquatic species.	Ensure the disturbed areas are revegetated to arrest occurrence of soil erosion	During rehabilitation works	• Contractor	No sites in the surrounding environment are opened up to soil erosion.
4.	Increased fish abundance in the dam due to favorable breeding	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries shall regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	• Fisheries department • DMC	Dam management by-laws drafted by completion of rehabilitation works

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
	and feeding grounds				• Local traditional leadership	
5.	Increased impacts on the species of conservation concern	To avoid any mortalities of these species	The contractor shall conduct robust visual observations before undertaking any works The DMC and fisheries shall implement a monitoring survey of this species post-construction.	During and after rehabilitation works	• Contractor • Fisheries department • DMC	No mortalities recorded for every 6 monthly reporting period
Operation phase						
1.	Increased feeding and breeding grounds for fish once the dams are restocked with fish	To main the feeding and breeding grounds for fish and ensure sustenance of fish production.	DMC and Fisheries shall protect the breeding grounds for fish by ensuring no fishing activities take place in shallow waters. DMC and Fisheries shall protect vulnerable fish species by monitoring the quantities and using safe fishing methods DMC shall monitor and control invasive weedsProtect the breeding	During and after rehabilitation works.	• Department of Fisheries • Local Traditional Leadership • DMC	Dam management by-laws drafted by completion of rehabilitation works.
2.	Bed modification: Low deposition of silt	To maintain reduced siltation in the dam so as to maintain diverse habitats.	DMC shall maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders shall	During and after rehabilitation works.	• Forestry Department • Fisheries Department • Local Traditional Leadership	Dam management by-laws drafted by completion of rehabilitation works.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			conduct catchment management (Appendix 8)		• DMC	
3.	Increase in solid waste disposal in the reservoir compromising water quality and thus affecting aquatic species due to decomposition of organic matter, depleting oxygen in the reservoir	To keep the dam free from solid waste disposal to ensure good water quality. No debris to obstruct sunlight for photosynthetic processes guaranteeing oxygen generation in the water column for aquatic species	DMC shall protect the dam from solid waste disposal by completely arresting indiscriminate disposal of waste.	During and after rehabilitation works.	• DMC • Local traditional leadership	Reports from DMCs to the District Management Committee on solid waste disposal submitted every month. Management of generated solid waste in the community close to the dam in place.

* = Non-wood forest products.

Evaluation of monitoring

The evaluation of the monitoring programme will be on-going and as follows:

- Daily: General monitoring updates, reporting of incidents impacting biodiversity and emergency response;
- Monthly: Compilation of monitoring progress report, environmental training delivered, details on any major incidents/events, general progress of the monitoring program; and
- Quarterly: Summary report on quarterly biodiversity monitoring programs, review quarterly performance and apply adaptive management if required.

Implementation of the BMP

Step 1: Roles and responsibilities of different stakeholders for BMP implementation

Table 0-30Roles and responsibilities of relevant stakeholders in in BMP implementation

Name of Authority/ Entity	**Key Role and Responsibility**
IDSP/ Ministry of Agriculture	IDSP under the Ministry of Agriculture (MoA) bears the overall responsibility of ensuring that the implementation of the project in its planning, rehabilitation, operational and demobilization phases follows the environmental safeguards prescribed in the BMP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader additional financing activities, it has contracted UNOPS to oversee and implement the remediation works of the remedial dams, including Chikowa Dam. The IDSP-PIU E&S Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities of the UNOPS Sub-PIU and UNOPS contractor at the Chikowa Dam. The IDSP-PIU shall retain the primary responsibility for ensuring that environmental and social commitments for the Chikowa Dam are met throughout the sub-project lifespan vis-à-vis the World Bank. • The IDSP-PIU will establish a schedule of supervision and monitoring for the BMP of the Chikowa Dam. • The IDSP shall have an environmental specialist who shall oversee the UNOPS staff with regards to the BMP tasks. At least one additional MoA field staff member with HSSE responsibilities will be located at Chikowa damfor continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP. • The safeguards supervision includes the operationalization of the dam, during which period the IDSP personnel will be working with the respective local authorities, DMC and local communities, in preparation for smooth handover when IDSP ceases to exist as a project. • The PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the DMC. • IDSP will implement its own monitoring and supervision activities as they apply for

	all activities, including the remediation of Chikowa Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS shall jointly discuss any necessary amendments to activities, where necessary.
UNOPS/ Supervising Engineer	The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Chikowa Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this BMP. UNOPS has been tasked with the design of the remedial works and the preparation of this BMP. UNOPS shall further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works including the implementation of safeguards mitigation measures. Specifications for safeguards derived from the BMP shall be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as BMP. The bidding documents will contain a general reference to the necessity to comply with this BMP and will detail key tasks/mitigation measures/trainings, which the contractor shall be obliged to undertake as part of his deliverables. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the BMP mitigation measures laid out in this BMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The environmental specialist, social specialist and ecological specialist will be involved in the environmental and social management of Chikowa Dam. In addition, the team will supervise and monitor the implementation of the BMP mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU. UNOPS shall be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance. • UNOPS shall ensure regular supervision and monitoring of the implementation of all mitigation measures laid out in this BMP, as well as all trainings and other required activities. • UNOPS shall use the indicators all mitigation measures, as listed above in this BMP, for its monitoring activities. • A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the BMP, confirmed the supervision of the safeguards specialist on site, photos, records of works, restoration efforts, terrestrial and aquatic environments management, grievances, accidents, communication, and training, among others. • UNOPS shall monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate.

	• UNOPS shall take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks shall cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non-compliance situations shall be dealt with in accordance with the set procedures in the contract.
ZEMA	To undertake enforcement, compliance, review and monitoring of environmental assessment management plans. Visit, inspect and monitor the site or specific activities at any particular time
Government ministries and other stakeholders- Pemba district	The duty of the local authorities in the project area of influence with regards to the BMP is to coordinate with the project and stakeholders (s) on BMP commitments pertaining to site assessments, habitat management, fishing methods, re-vegetation, capacity building and training, inspections and participating in the project public outreach. The stakeholders have operation responsibilities for habitat management. The IDSP shall inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP shall be communicated to relevant ministries indicated.
Contractor	UNOPS shall contract the contractor after preparation of bidding documents. The selected contractor shall comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor shall engage competent full time Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP/ BMP. The Officer will be responsible for implementation and monitoring the contractor‘s compliance with the BMP requirements and the environmental specifications. The duties of the Officer shall include but not be limited to the following: a) carry out environmental including biodiversity site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to biodiversity. If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the biodiversity requirements and submittals should be discussed, both for day-to-day work and for environmentally critical stages or activities. • Contractors provide details on contractor's oversight on safeguards performance;

	• Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns of their workers;
	• Contractor shall prepare and affirm all plans and method statements required in this BMP and ESMP that affect biodiversity and habitats prior to construction activities
	  • Borrow pits and material sites
	  • Contractor emergency response plan
	  • Waste management
	  • Campsite activities
	  • Excavation works and stock piling
	  • Sanitation and water management
	  • Traffic management and access routes management
	  • Biodiversity management
	  • Training, engagement and sensitization
	• Contractor shall work within the requirements of legislative requirements and standards
	• Contractor shall carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor shall carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact.
	• Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS.
	
	The contractor must report on all HSSE matters related to this BMP to UNOPS on a monthly basis. UNOPS shall administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this BMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local DMC and local authorities.

Local community and DMC	As owners of the dams, the dam community will be encouraged to be active partners during the construction. It will be regularly consulted on a variety of issues. It will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the Grievance Redress Mechanism (GRM), which has been designed for the AF activities. Community members will be appointed by the DMC to verify that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) in the ESMP, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the biodiversity mitigation measures undertaken. The dam is operated by a DMC, which consists of community members. The Chikowa DMC is active, consisting of three women and seven men (Refer to the ESMP). Due to

	the complexity of managing dams, the management structure is widened to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been involved during planning, construction and operation phases. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training. Upon completion of the remedial works, there will be a hand-over of the management, operation and maintenance of the dam to the Chikowa DMC. In order to successfully operate the dam, and limit impacts on people and environment, the DMC members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; habitat management; dam usage and best practice, biodiversity protection, erosion control and conservation (see training plan is included in the ESMP). Quarterly reports will also be made available to the local DMC and local authorities. MoA has representatives at the dam who will periodically report to IDSP.

Step 2: Incident Reporting

The contractor, UNOPS, and IDSP are required to report on any environmental and biodiversity incidents related to the sub-project activities. The contractor shall form the incident investigation team and shall provide incident reporting on a monthly basis to UNOPS, and UNOPS shall include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process below:

1) Initial communication
2) Classification: how serious?
3) Notification: Who? How: When?
4) Investigation: What happened? How and Why?
5) Response: Remedial actions?; Preventive actions?
6) Follow up: Is response Complete? Was it effective? Lessons?

Incidents should be categorized into 'indicative', 'serious' and 'severe' (Refer to World Bank classification of incidents in the ESMP). 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment. A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide). A 'severe' incident causes great harm to individuals, or the environment, or presents significant reputational risks to the World Bank. Incident reports should use the format in the ESMP.

Step 3: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Chikowa DMC who are part of the local community and local authorities. IDSP will continually engage with the communities and local authorities throughout the lifespan of the dam.

REFERENCES

1. Ansell, W. F. H. (1960): Mammals of Northern Rhodesia. A revised check list, notes on distribution, range maps and summaries of breeding and ecological data.
2. Aspinwall, D., Bingham, M.G., Chundama, M., Jeffery, R.C.V. & Sinkamba, M. (1996). Zambia: A Natural Resource profile. World Wide Fund for Nature (WWF), Lusaka.
3. Barker, P. (2001). A Technical Manual *for Vegetation Monitoring. Resource Management and Conservation,* Department of Primary Industries, Water and Environment, Horbat. 79pp.
4. Benson, C.W., Brook, R.K., Dowsett, R.J. & Irwin, M.P.S. (1971). The Birds of Zambia. Collins, London
5. Branch, B. (1998). Field Guide to Snakes and Other Reptiles of Southern Africa. Cornelis Struik House, Cape Town, South Africa
6. Broadley, D.G. (1971). The Reptiles and Amphibians of Zambia. Puku 6: pp143
7. Carrothers, V., (2016). Wildlife of Southern Africa. A field guide to animals and plants of the region. Published Struik. Nature Random House, South Africa.
8. Chidumayo, E. N. (1987). *Species structure in Zambian Miombo Woodland*. *J. Tropical Ecol*. 3: 109 – 118.
9. Chidumayo, E. N. (1993). *Responses of Miombo to Harvesting: Ecology and Management*. Stockholm Environment Institute.
10. Desanker, P. V., Frost, P. G. H., Justice, C. O. and Scholes, R. J. (eds). 1997. *The Miombo Network: Framework for a Terrestrial Transect Study of Land-Use and Land-Cover in the Miombo Ecosystems of Central Africa*. IGBP Report 41 Stockholm, 109pp.
11. Ellison G (1993): Common birds of Zambia.
12. Florida Keys national marine sanctuary. (2002). Accessed online floridakeys.nooaa.gov on 30th April, 2021.
13. Guy, P. R. (1981). *Changes in the biomass and productivity of woodlands in the Sengwa Wildlife Research Area, Zimbabwe*. *J. Applied Ecol*. (18): 507 – 519.
14. Hussey, B. M. J. (2001). *Photographic Monitoring of Vegetation. Wildlife Notes.* (9): 7pp. Information Notes for the *Land for Wildlife* Scheme in Western Australia.
15. IUCN (2021). Red list of threatened Species. Accessed online. https//www.iucnredlist.org/species/60623/12385801#text-fields on 11th May, 2021.
16. Jeffery, R.C.V., Phiri, P.S.M., Chipungu, P.M. & Nefdt, R.C.J. (1998). Literature Review of Biotic Resources of the Nchanga Mine, Nkana Mine-smelter Complex. and Chambeshi Smelter. African Mining Consultants, Kitwe.
17. Kleynhans CJ. 1996 A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. *Journal of Aquatic Ecosystem Health* 5: 41–54.
18. Klaver, R. W., Singh, A. and Fosnight, E. A. (1998). *Global Forest Fire Watch: Wildfire potential, detection, monitoring and assessment. Presentation made at the First International Conference on Geospatial Information in Agriculture and Forestry*.
19. Leonard, P. (2005). Important Bird Areas in Zambia. The Zambia Ornithological Society, Lusaka, Zambia
20. Picker, M., Griffiths, C. & Weaving, A. (2004). Field Guide to Insects of Southern Africa. Cornelis Struik House, Cape Town, South Africa
21. Simbotwe, M.P.M. & Mubamba,R. (1993). A Guide to Reptiles, Amphibians and Fishes of Zambia. Ed: R.C.V. Jeffery. Wildlife Conservation Society of Zambia, Lusaka.
22. Sims & Blaylook (2002). A key to identifying macroinvertebrates
23. Sinclair, I. & Ryan, P. (2003). Birds of Africa – South of the Sahara. A Comprehensive Illustrative Field Guide. Cornelis Struik House, Cape Town, South Africa
24. Skelton, P. (2001). A complete guide to the freshwater fishes of Southern Africa. Struik Publishers, Cornelis Struik House, 80, Mckenzie Street, Cape town, 8001, South Africa.
25. Sutherland J. W (ed) (2006). *Ecological Census Techniques.* Cambridge University Press
26. Tahmiscioğlu, M.S., AnuL, N., Ekmekçi, F., & Durmuş N. (2004**).** Positive and negative impacts of dams on the environment. Accessed online: https://cvc.ca/wp-content/uploads/2011/02/60.pdf on 30th April, 2021.

27. Tanabe, Y., Hori, M., Mizuno, A.N., Osono, T., Masaki Uchida, M., Kudoh, S. & Yamamuro, M. (2019). Light quality determines primary production in nutrient-poor small lakes. Accessed online https://www.nature.com/articles/s41598-019-41003-9 on 30th April, 2021.

28. Utsugi, K. & Mazingaliwa, K. (2002). Guide to Zambian Fishes, Planktons and Aquaculture. Published by JICA, 2002.
29. Walker, C. (1996). Signs of the Wild. A Field Guide to the Spoors and Signs of the Mammals of Southern Africa. Cornelis Struik House, Cape Town, South Africa
30. William Latimer (2009) Assessment of Biodiversity at the Local Scale for Environmental Impact Assessment and Land-use Planning, Planning Practice & Research, 24:3, 389-408,
31. Zambia Wildlife Authority (ZAWA), (2006). *Vegetation monitoring manual for the Kafue National Park*, Zambia, 52-53pp.

Appendix 1: Sample Plots Coordinates

COORDINATES FOR CHIKOWA DAM		
Sample Plot No.	**Coordinates in degrees ˚**	
	South	**East**
1.	S 13.43486	E 032.11007
2.	S 13.43642	E 032.11010
3.	S 13.34870	E 032.11061
4.	S 13.44043	E 032.11061
5.	S 13.43827	E 032.11327
6.	S 13.43447	E 032.11381
7.	S 13.43638	E 032.11512
8.	S 13.43173	E 032.11075
9.	S 13.43760	E 032.10529
10.	S 13.43535	E 023.10618
11.	S 13.43880	E 032.10608
12.	S 13.43946	E 032.14072
13.	S 13.44065	E 032.10872
14.	S 13.44289	E 032.10918
15.	S 13.44287	E 032.10692

Appendix 2: Main Plot data collection form

TREE PARAMETERS DATA FORM						*FORM A*
Altitude……	**Plot No……..**	**Date……**		**Quadrant No……**		**Plot Size……..**
Centre of Plot (GPS Reading UTM) N…….. E……..		**Vegetation Type……..**				
Recorder……..						
SPECIES (TREE ≥ 5CM)	**HEIGHT (M)**	**DBH (CM)**	**CROWN SIZE** a Width	b Length	**STEM HT (M)**	**NOTES****

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertain; (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and + / -)

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Appendix 3: Regeneration Plot Data Collection Form

TREE REGENERATION DATA FORM				*FORM B*
Altitude……	**Plot No……..**	**Date……**	**Quadrant No……**	**Plot Size……**
Centre of Plot (GPS Reading UTM) N…….. E……		**Vegetation Type……**		
Recorder……..				

SPECIES	COUNT	NOTES**

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertai (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Appendix 4: Fauna Data Collection Form

Mammals

	Species		No. Seen		Signs - write details	Other faunal species
1						
2						**Reptiles**
3						
4						
5						
6						
7						
8						
9						
10						
12						
13						
14						**Amphibians**
15						

Birds

	Species		No. Seen		Signs - write details	
1						
2						
3						
4						
5						
6						
7						**Invertebrates**
8						
9						
10						
12						
13						
14						
15						

Fire occurrence

☐ Recent

☐ Old

Notes

Appendix 5 Data Collection Sheet

The Aquatic Biodiversity Check List for the 10 Dams in Zambia

Biodiversity Scoping

Identification of habitats

- ✓ Is the direct area of influence considered to be modified/converted, natural, or critical habitat?
- ✓ Is the indirect area of influence considered to be modified/converted, natural or critical habitat?
- ✓ What is the legal protection regime?
- ✓ Is the direct area of influence located on indigenous land?
- ✓ What are the existing drivers of habitat loss (irrespective of the dam) ?

Identification of key biodiversity features

- ✓ Is it a priority area for conservation? (existing or proposed protected area, indigenous or local communities protected areas, Ramsar sites, area with high level of endemism, presence of aquatic corridor to ensure genetic diversity, important spawning area etc.). Note: List all sites within a 50km radius from the dam.
- ✓ Are there any Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) species and/or endemic or restricted-range species within a 50 km radius from the dam ? If so, list the species and their conservation status (based on the IUCN Red List)
- ✓ Does the area support important ecological processes? (spawning site? sediment supply to a wetland downstream? fish migratory route ? etc.)
- ✓ Are there any priority ecosystem services in the area of influence that may be affected by the dam ? If so, is it critical to the livelihoods of indigenous communities?

Identification of Aquatic species

- ✓ What is the conservation status of the vertebrate and invertebrate species?
- ✓ What is the conservation status of the macrophytes?
- ✓ Is there any migratory fish species ? List those species (if applicable) and shortly describe the migratory dynamic.

Aquatic biodiversity impact assessment and management

- ✓ What are the potential impacts and risks (direct, indirect, induced and cumulative) of the dam and how it would affect the key biodiversity features (if any)? Shortly describe impacts for each project phases (construction, operation and decommissioning)
- ✓ Would the dam lead to long term declines in population of any species listed either as CR, EN, VU or NT?
- ✓ Will the project significantly affect critical natural habitats or natural habitats?
- ✓ Would there be any significant changes in the water flow that could affect the aquatic and/or the riparian habitat and species?
- ✓ Is there any residual biodiversity impacts anticipated?
- ✓ In the case of residual impacts, is there sufficient information to plan management actions required to mitigate, or compensate for this type of impacts? Or additional baseline studies are required?
- ✓ Is it possible to improve the project's design to avoid (and if not possible, to minimize) the project's impact?
- ✓ What are the potential options for biodiversity conservation and enhancement?

Monitoring

- ✓ Is the baseline information gathered sufficient to produce standardized biodiversity indicators useful for monitoring changes in the biodiversity overtime?

SAMPLING FORM 1
FISH SPECIES

A. Length-Weight Data

To be completed at every sampling point **Sampling Day:……..**
Coordinates:…….. Date:……/……/…….

Sample ID	Name of Species (common name and *Latin name*)	Number	Length (mm)	Weight (g)	Gear	IUCN Conservation status	Migratory species (yes/no)	Endemic, restricted-range specie (yes/no)
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								
21.								
22.								
23.								
24.								
25.								
26.								
27.								
28.								
29.								
30.								

Sampling Form 2
WATER QUALITY

B. Physicochemical Parameters

Sampling Point …… Sampling Day:……
Coordinates:…… Date:……/……/…….

SAMPLING POINT	DO (mg/L)	Temp (C^0)	pH	Cond mS/m	Sech. reading	TDS	Total hardness	Alkalinity	Turbidity
Values of references									
downstream									
Upstream									
Mid of the dam									
At the weir									

Sampling Form 2

C. Aquatic plants

Sampling point …… Sampling day:……
Coordinates:…… Date:……/……/…….

S/#	Species	Monocots	Dicots
Emergent			
Submerged			
Free floating			

Macroinvertebrates survey

Order	Sub/Family	English name	Comments
Odonata	Libellulidae	Dragonflies	
	Aeshnidae	Dragonflies	
Diptera	Tabanidae	Horseflies	
	Culicidae	Mosquitoe	
	Chironomidae	Midges	
Coleoptera	Gyrinidae	Whirligig beetles	
Hemiptera	Corixidae	Water boatmen	

	Gerridae	Pondskaters/water striders	
Ephemeroptera	Baetidae	Mayflies	
Crustacea	Potamonautidae	Crabs	
Gustropoda	Thiaridae	Snails	
Any other species			

Appendix 6 – Water Analysis Results for water samples collected at Chikowa Dam

	Chikowa Dam Wall	**Chikowa Dam Entry**	**Chikowa Dam Mid**	**Chikowa Dam Downstream**	**Chikowa Dam Upstream**
Sampling date	**22.04.2021**	**22.04.2021**	**22.04.2021**	**21.04.2021**	**22.04.2021**
Parameter					
pH	6.87	6.72	7.05	6.74	6.73
Conductivity (µs/cm)	222	230	230	222	228
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	4.60
Nitrates (as NO_3–N mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	100	100	108	88	84
Total Dissolved Solids (mg/l)	112	115	116	112	114
Ammonia (as NH_4-Nmg/l)	8.40	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	0.90	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	6.1	4.6	5.2	4.0	4.4
Chemical oxygen demand (as mg O_2/l)	4	4	3	4	3
Chlorides (mg/l)	15.0	15.0	10.0	19.0	16.0
Turbidity (NTU)					
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005

Appendix 7 Planktons

Plankton composition at Chikowa Dam

No.	Phytoplankton	Zooplankton
1	*Anabaena sp.*	*Moina micrura*
2	*Trachelomonas*	*Diaphanosoma brachyurum*
3	*Navicula* sp.	*Brachionus caudatus*
4	*Pediastrum* sp.	*Brachionus falcatus*
5	*Synedra*	*Brachionus budapestinensis*
6	*Euglena* sp.	*Kerratella valga*
7	*Microcystis* sp.	*Cyclops*
8	*Urothrix*	*Diurella stylata*
9	*Anabaena smithii*	*Trichocerca cylindrical*
10		*NaupliusS*
11		*Asplanchna herricki*
12		*Simocephalus vetuloides*
13		*Cydorus sphaericus*
14		*Ceridaphania cornuta*
15		*Macrothrix spinosa*
16		*Asplanchona sp*
17		*Daphnidae*
18		*Lepadella oblonga*

Appendix 8 Habitat Management

Catchment Management and Dam/ Dambo Management Guidelines

a) **General Integrated Catchment Management Guidelines**

A Catchment means a geographical area which naturally drains into a water resource and from which the water resource receives surface or ground flow that originates from rainfall[22]. During the ESMP and BMP assessments for the rehabilitation sub-project, concerns were expressed about the management of the upper catchment of the stream, which should be handled by stakeholders in the operation phase for sustainability.

These concerns related mainly to existing land use practices and resulting erosion and siltation problems including water quality problems. The present land-use practices at the Chikowa Dam sub catchment may be unsustainable due to issues related to crop farming close to the water bodies, livestock grazing, livestock watering practices, tree cutting, fuel wood collection and fires. These result in high sediment loads and nutrient enrichment of the water bodies, particularly after rainfall events, thus impacting on the water quality with the potential to undermine the long-term storage capacity of the Dam and dambos which will affect the biodiversity habitats.

To address these, and other concerns in the catchment, the Water Resources Management Authorities (WARMA) provides for catchment management and local government offices and DMC have to put in place catchment management to examine land-use practices within the dam catchment, to identify key areas to be targeted to move towards more sustainable management of the catchment, and to develop a plan that serves these ends while also identifying how local communities can benefit through the proposed activities. A draft plan that can be used by the stakeholders is presented below:

1) Policy and regulatory framework with the relevant institutions
    - Forest Act No. 4 of 2015
    - Fisheries Act of 2011
    - Water Resources Management Act (WARMA) No 21 of 2011 and Department of Water Resources Development DWRD- Reference for catchment management provisions
    - Zambia Wildlife Act of 2015
    - Water Act, 1964
    - Lands Act of 1964
    - Agriculture Lands Act No 57 of 1960; and
    - WASH legislation

According to WARMA, The Water Resources Management Act of 2011 provides for a decentralized management system in line with the principles of Integrated Water Resources Management (IWRM) that manages water resources at catchment and sub-catchment levels and promotes local participation through formation of Water User Associations (WUAs)/ DMAs. Functions of catchments and sub-catchments (enshrined in Part III section 18 & 20 of WRM Act No 21 of 2011):

- Coordinating, supervising, monitoring and evaluating Water Resources Management activities in the water catchments
- Disseminating Water Resources Management information, regulations and standards to the public

[22] WARMA Act

- Collecting, monitoring and analyzing hydrological and hydrogeological data for WARMA decision making
- Developing water allocation plans and making recommendations on water allocations for the issue of permits
- Contributing to the development of catchment management plans, sub catchment plans for water allocation decisions and other water use plans
- Promoting participatory water harvesting and water conservation initiatives

2) The vision for the integrated catchment management plan for the Chikowa Dam catchment can be derived from the key issues raised in the consultation process, which is to ensure sustainable land use practices to protect the water resources of the catchment while enhancing biodiversity, dam uses and the livelihoods of the communities in the catchment.

3) Underlying this vision, are the following aims of the plan, derived from the studies and the consultation processes:
   - To provide for the establishment of a Catchment Council/ Catchment Management Committee, which will coordinate and oversee the preparation and implementation of the plan
   - To provide a snapshot of the current status of the catchment
   - To ensure ongoing engagement with stakeholders on the priorities and implementation of the plan
   - To ensure the reduction of soil erosion and sedimentation in the catchment and to protect the water quality of the dam
   - To support the improvement of livelihoods of the communities in the catchment
   - To address other key biodiversity related issues in the catchment, as will be identified.

4) Principles that drive conceptualization and implementation of the plan.
   - Participatory management
   - Using labor intensive/ involving approaches
   - Using local resources
   - Empowering local communities, particularly women and youth
   - Sustainability

5) Catchment-wide projects shall be proposed to protect the dam, or may already be in place or planned for implementation. These can include:
   - Communication and awareness
   - The establishment and functioning of the Council
   - Formulation and training of the DMC and users association
   - Community capacity building and training;
   - Provision of sanitation facilities
   - A sustainable livelihoods programme
   - A sediment management programme
   - A reservoir/ dam management plan
   - A dam sediment study
   - The establishment of new monitoring points and revision of monitoring frequency
   - Implementation of water quality monitoring variables
   - Accreditation of a water laboratory
   - Zoning plan for use of upper catchment

- Mapping of key wetlands
- Development of policy on management of invasive plants
- Creation of indigenous plants nursery
- Energy sources assessments
- Provision of off-channel livestock watering points
- Zoning of buffer zone around dam
- Dam and Dambo Management

6) Time lines:

It will take time and years for the activities identified in the plan to change the current land-use practices across the catchment, but there will be a good foundation of community understanding of the issues on which to build, and there are already good practices in the catchment which can be built on, developed further, and disseminated more widely.

7) Funding:

For catchment management to be sustainable in the long-term, sustainable funding beyond what is currently available through the dam rehabilitation sub-project is required to continuously support the catchment management activities. These include the sustainable funding for the functioning of the committee, which will require relatively small amounts, and funding for the implementation of catchment management activities, which will require larger amounts. Total estimated costs will be established by the stakeholders council for instance for the first 5 years then per annum costs. There are three potential sources of funding for implementation: donor funding, funding from government budgets, and funding through introducing a system of Payment for Environmental Services (PES)/ User fees (WARMA Act). These require significant discussion and engagement between the community, policy makers, stakeholders and government representatives.

Dam/ Dambo Management

This section provides guidance on retaining, maintaining and where necessary re-establishing vegetated riparian buffers around the sensitive water resources (stream, dam / dambos) managed, and work sites (campsite, slopes, borrow areas etc.) as pointed out by the area of influence and in the BMP management plan Section 5. The following riparian zone management procedures shall be implemented:

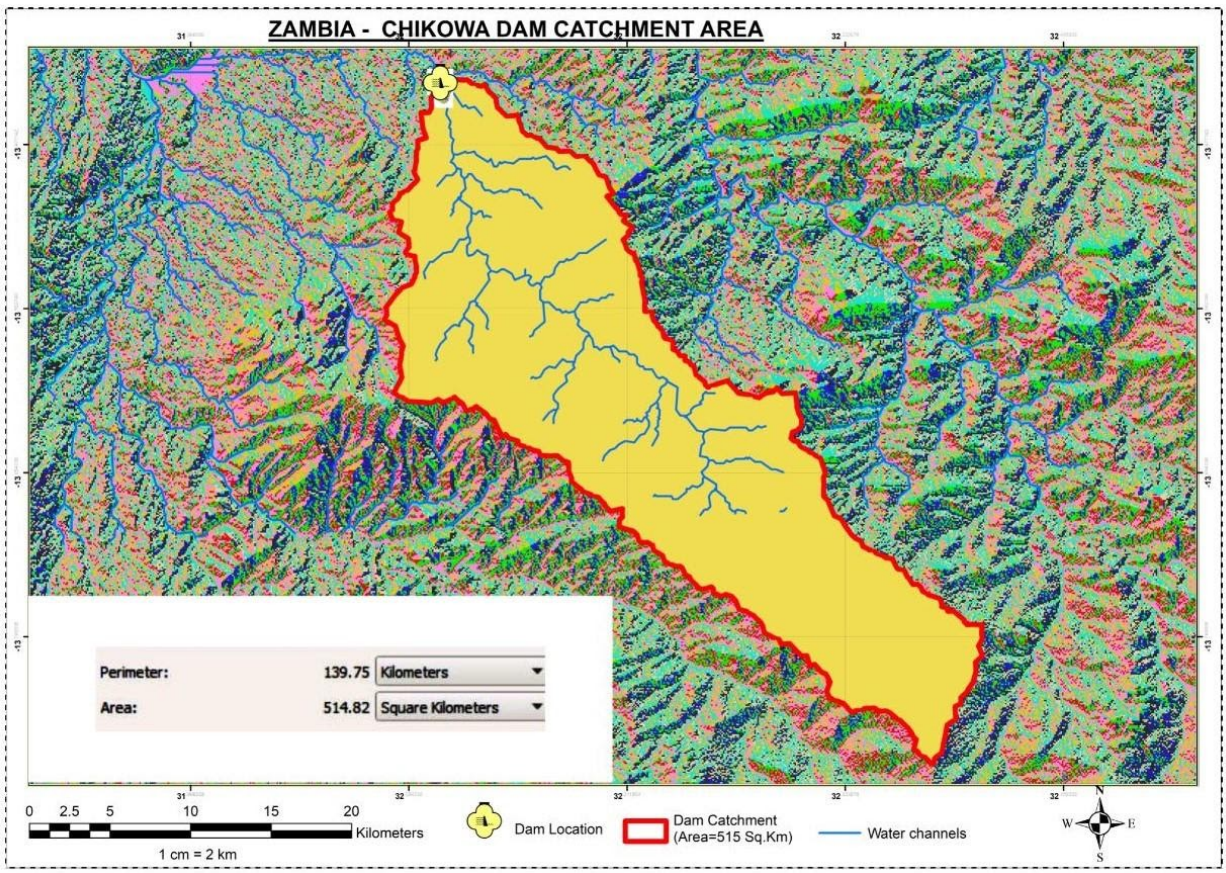
- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the adjacent area or more as approved by the engineer. Planted buffers should consist of a mix of native trees, shrubs and groundcover using natural and assisted vegetation as indicated in the ESMP.
- These buffers and revegetated sites should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove invasive species, for hazard reduction to prevent wild-fires and ensure community safety.
- Riparian vegetation provides a natural boundary. Buffers should be measured outward from any recognized damp land vegetation fringing the water resource or where the margins of missing riparian vegetation are uncertain, and the rain season banks of the water body.

- Buffer composition should comprise under-storey vegetation (grasses), over-storey (tall shrubs, trees) and carbon-rich tree parts on the ground matching the density and diversity of undisturbed local native vegetation.
- Wildfires control measures must be in place to protect riparian buffer zones.
- Unpaved roads pose a risk to waterbodies due to stormwater causing surface erosion and associated water channeling which increases the rate of contaminated water movement. These must not be close to the dam or dambos. There shall be a buffer between the busy roads and the water bodies.
- Maintaining some grass at the water inlets to beneficial for sediment and contaminant filtration purposes.
- Contamination prevention is important with land use activities set up and operated to have minimal impact on buffers and associated water resources. Precautionary strategies to protect buffers from harm, erosion may include:

a. restricting land disturbance activities to the low rainfall seasons;
b. managing stock numbers, feeding, watering and location to lower risks areas;
c. isolating potentially harmful materials from water;
d. immediate and effective waste spill clean-up;
e. use of structural stormwater retention/ drainage systems/ slopes;
f. implementation and sensitization of environmental management plans; and
g. training of staff, locals and contractor in good operational practice.

Appendix 9 Hydrology and Ecological Flows

Chikowa Dam Catchment



Flows at Chikowa Dam after the rains in April, 2021

Flows, July 2020: reduced flows due to the non-perennial river's flow regime