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 Ngolongozya Dam

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Prepared by UNOPS for the Government of the Republic of Zambia

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AF	Additional Financing
BDA	Biodiversity Assessment
BMP	Biodiversity Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on International trade in Endangered Species
CoC	Code of Conduct
COD	Chemical Oxygen Demand
COVID-19	Corona Virus Disease 2019
CpUE	Catch Per Unit
CR	Critically Endangered Status
DMC	Dam Management Committee
DWRD	Department of Water Resources Development, previously Department of Water Affairs, WRDP implementer
E&S	Environmental and Social
EHS	Environmental, Health and Safety Guidelines
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
EPB	Environmental Project Brief
FAO	Food and Agriculture Organization of the United Nations
FD	Department of Forestry
fsl	Full Surface Level
GBV	Gender Based Violence
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

IV	Important Values
KBA	Key Biodiversity Area
LC	Least Concern Status
LMP	Labor Management Plan
MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
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
PIU	Project Implementing Unit
RBA	Relative Basal Area
RD	Relative Density
RF	Relative Frequency
SEF	Safety Evaluation Flood
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
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
VU	Vulnerable Status
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

Ngolongozya Dam is located in Zimba District in the Southern 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. The dam was newly constructed under the Water Resources Development Project (WRDP) in 2016. Subsequent works included the raising of the embankment for additional storage and freeboard by 2m, the raising of the spillway by 1m, and the construction of the spillway training wall and two new drop structures (COWI, 2018s)[1]. The dam was initially built for irrigation, fishing and livestock watering purposes.

The initial construction works were managed by the WRDP, which was funded by the World Bank. The WRDP 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 work at the dam. Despite efforts to bring the project back on track, the project continued to remain out of safeguards compliance. The WRDP was closed in 2018.

The World Bank has provided Additional Financing (AF) to the IDPS to support remedial works on 10 of the dams constructed or rehabilitated by the WRDP, including Ngolongozya Dam. The United Nations Office for Project Services (UNOPS) is tasked with overseeing the works and with preparing this Environmental and Social Management Plan (ESMP) and Biodiversity Management Plan (BMP). The BMP was prepared as a separate report and annexed to this ESMP. 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.

UNOPS has proposed to maintain the existing spillway width of the dam, raise the embankment by 1.2m and provide a drift crossing over the realigned centerline of the spillway. UNOPS has developed detailed designs for the remedial works on Ngolongozya Dam. The works will not change the nature and scope of the existing dam operation activities. They will be implemented in two ways: a) construction and demobilization activities, and b) the existing sites' remediation activities.

Institutional Arrangements: The sub-project works on Ngolongozya 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 will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works on the ten selected dams, including the Ngolongozya 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 contractor personnel to the IDSP-PIU through the AF Project Grievance Redress Mechanism (GRM). Upon completion of the works, the management, operation and maintenance of the dam will be handed over to the Ngolongozya dam committee. In order to successfully operate the dam, and limit its negative impacts on people and environment, the dam committee members and the communities will receive capacity building and training.

[1] IDSP, Environmental and Social Audit, 2020.

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; BMP; 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 is included in this ESMP in order to identify, rehabilitate and remediate environmental and safety issues caused by the past construction works, as well as to enable completion of existing incomplete dam construction, and to outline the requirements to return disturbed sites to a state that is similar to that prior to construction.

The key structural legacy issues of Ngolongozya Dam include that the design was not fit for the increased rainfall the region would experience. Due to increased rain, an emergency raising of the dam by a further 1.5m was undertaken in 2019 by the Zambia National Service in order to avoid overtopping. The dam wall crest is 5m to accommodate light traffic across the wall. The concreted 4m wide sill defines the spillway and serves as a drift crossing for the community. There is a crossing challenge for vehicles due to the narrow crest width and the spillway crossing floods during the rainy season. In addition, between the time of construction to now , the spillway return channel has been damaged, with a complete breakthrough of the training wall, which appears to have deposited sediment in the toe area of the wall.

Health and safety and non-structural risks related to legacy issues of the dam include unrehabilitated contractor sites that pose health and safety issues for the community; the inability to monitor and assess downstream ecological effects of the dam operation; loose soil causing soil movements and open sites; possible vector breeding areas that may cause drowning risks; lack of safe and adequate access across the river; as well as injury and drowning risks for community members related to lack of awareness.

Social concerns include the failure to complete the dam construction and hand the dam over to the district administration and communities. This included a lack of capacity building and training of community members to benefit fully from irrigation water supply and other dam uses. As a result, the dam was never stocked with fish, and the irrigation system was never operationalized. This, in turn, poses risks of food insecurity. Furthermore, there is a lack of functioning irrigation outlets, which has resulted in a lack of water supply for gardens and uncontrolled stock watering.

Lastly, the ESMP includes a capacity building and training plan that lays out the necessary training for dam committee members, communities and other stakeholders in relation to the construction and operation phase of the planned works at Ngolongozya Dam. Similarly, a stakeholder engagement plan contains the detailed modes of engagement with a variety of stakeholders in order to ensure appropriate dissemination of all information regarding the works; and to allow for consultation of stakeholders on dam-related environmental and social issues. A Grievance Redress Mechanism (GRM) has been designed for the AF to allow stakeholders to file any feedback or grievances and receive appropriate responses from the IDSP.

1. Introduction

Ngolongozya Dam is located in Zimba District in the Southern Province of Zambia. It is one of 10 dams that have been selected for remedial works under the World Bank funded IDSP. According to OP 4.37, the dam is classified as a small dam because its height is less than 15m. The current structural integrity of Ngolongozya Dam has been heavily compromised by the initial construction works. This has become a threat to the safety of the local community and downstream users. 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 environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders, and collection of field data at the dam site using field specific equipment. Initial field screening visits by the team revealed that an in-depth biodiversity assessment of the dam site was required. The biodiversity assessment was undertaken, the data analyzed and a Biodiversity Management Plan prepared, which is annexed to this ESMP.

Dam rehabilitation works will commence after the approval and disclosure of this ESMP. The ESMP will be communicated to the stakeholders prior to the works. Dam rehabilitation works are anticipated to take 6 months.

1.1 Project Background and Description

The initial construction works of Ngolongozya Dam started in 2016 by Savenda, under the Zambia Water Resources Development Project (WRDP) (P114949). Subsequent works included the raising of the embankment for additional storage and freeboard by 2m, the raising of the spillway by 1m, the construction of the spillway training wall and construction of two new drop structures (COWI, 2018s). The dam was initially built for irrigation, fishing and livestock watering. However, it does not have working outlets, as these are incomplete.

The Water Resources Development Project (WRDP)

WRDP became effective in 2013 and was closed in 2018. The PDO of the WRDP 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 for the design, rehabilitation and construction of 100 small dams. Of these, only 12 dam sites were procured for construction or rehabilitation. Ngolongozya Dam was one of them.

WRDP E&S Safeguards: The WRDP was classified as a 'Category B' project under the World Bank safeguards policies, and several policies were triggered. As a result, the following instruments were prepared, consulted and agreed upon: i) Environmental and Social Management Framework with a provision 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 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 Ngolongozya 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 the Zambia 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 issues, 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 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 project closure in 2018. Since the closure of the WRDP, 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 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 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) prepare an ESMP and Biodiversity Assessment and Management Plan; c) undertake limited, structural and non-structural interventions to minimize immediate risks to communities caused by the dam.

IDSP Additional Financing (AF)

The AF extends the original 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 Ngolongozya Dam and nine other dams will be implemented under activity 2.

Phase 2 of the 2019 agreement and activity 2 of the AF provide remedial activities to reduce the risks/impacts related to construction and operation of the Ngolongozya Dam and provide support

through training and capacity building, which is required to safely operate the dams 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 capacities. 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 Ngolongozya 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 dam committee comprising of members from the beneficiary communities;
e) Implementation of the ESMP, including remediation of environmental legacy areas, such as borrow pits, excavation pits, campsite, spoil areas, etc.; and
f) Training of communities on how to operate and conserve the catchment.

1.2 Objectives of the ESMP

This ESMP has been prepared to guide all the works on Ngolongozya Dam during Phase 2 of the IDSP AF. The main objectives of this ESMP are to mitigate against imminent identified risks to the environment, safety of communities, and their associated livelihoods, and to bring the dam construction and 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 Ngolongozya dam community, representatives of local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Ngolongozya dam site for detailed on site assessments of the environmental and social impacts of the sub-project and legacy sites. This ESMP has been guided by the Zambian Environmental Management Act EIA Regulations (1997), as well as by the World Bank's OPs. Reference is made to the initially prepared EPBs (DWRD 2017), the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (ESA) (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 (April 2020).

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 of 10 Dams (IDSP, 2020)
- Field studies by the UNOPS environmental and social 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
- Site environmental and social assessments
- Public participatory interviews, focus group discussions and community consultations.
- Environmental quality monitoring – water quality sampling and analysis.
- Ad hoc filling in of matrix and checklists based on 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
- Basic biodiversity management plan (to be updated through a separate Biodiversity Assessment and 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

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 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 included in this ESMP and contractor's compliance with the regulations during the rehabilitation of the dam will be ensured.
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.

	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 includes a BMP with detailed 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. 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 Department of Fisheries will be involved to train the community on relevant activities. UNOPS, on behalf of the GRZ, has included actions to ensure species are protected with the involvement of the Department of Fisheries in the District.
Lands Management			
The Lands Act,	The Department of Lands	UNOPS to ensure	No additional land is expected to be required for this sub-

1995 (CAP 292, CAP 289, CAP 288)	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.	enforcement during preparation and construction phase Monitoring: Ministry of Lands, Natural Resources and Environment Protection	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 will, on behalf of the GRZ, 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 13 of 1994 (Cap. 187)	The Act establishes the Agricultural Land Board and provides for its functions which inter alia includes; keeping under review the use that is being made of state land, outside urban	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Agriculture	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus 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.

	and peri-urban areas and to make recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.		
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, and 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 all activities will comply with the requirements of this regulation, if the protection of wildlife is required. The ESMP determines appropriate actions to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including an ecologist on the team.
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 complies with the provisions of these regulations during the course of employment.
Occupational Health and	Provides for the health and safety of persons at work	Contractor, UNOPS	UNOPS will, on behalf of the GRZ, ensure that the contractor complies with the occupational health and safety

Safety Act	and for the health and safety of persons in connection with the use of plant and machinery.	Monitoring: Ministry of Labour	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 die as a result of such accidents or diseases.	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 contractor will comply with regulations under this Act by registering with the Workers Compensation Board and by providing safe working sites.
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 will, on behalf of the GRZ, 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…).
The Gender Equity and	Taking of measures and strategic decisions to ensure	Contractor, UNOPS	Sub-project works and operation will require gender mainstreaming and prevention and mitigation measures for

Equality Act, 2015	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; 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	Monitoring: Ministry of Gender Ministry of Community Development and Social services	GBV UNOPS and its contractors will comply with all the regulations under this Act. This ESMP includes a gender equality and GBV action plan.
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,	UNOPS to ensure enforcement during preparation and construction phase	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

	coordination, mitigation and management of disaster situations and establishes the Disaster Management and Mitigation Unit (DMMU).	Monitoring: Office of the Vice President District Commissioner Office	for remedial actions that promote safety. The UNOPS and IDSP will involve the DMMU in implementing safety and emergency measures.
Zambia Coronavirus Disease (COVID-19) Statutory Instruments 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	Construction and operational activities will involve workers and the community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	UNOPS to ensure enforcement during preparation and construction phase	COVID-19 prevention and management measures are included in this ESMP.

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 applicable 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 Ngolongozya Dam subproject has not triggered the OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the subproject.

Table 2 Relevant World Bank Operational Policies (OP)

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 Ngolongozya 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 restriction etc. For the remediation works at Ngolongozya 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.
OP	Pest Management	The policy is triggered because of the potential impacts the activities of the IDSP to be supported with the AF could generate (in the use of agrochemicals) in agriculture expansion as result of the remediated dam all

[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.

4.09		to serve water provision for agriculture -irrigation. The IDSP Pest Management plan will be adhered to.
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 safeguards instruments that must be rectified. The previous ESMP prepared for 8 dams (including Ngolongozya) listed some of the ecological impacts associated with Ngolongozya Dam and flow regulation but argued in favor of the dam as a means of guaranteeing flow in the downstream system in the dry season and during times of drought. This presupposes that flows will be managed to benefit downstream ecology, which, given capacity limitations and cost, is far from certain; and while there may be benefits in supplementing ecological baseflows in dry periods, this does not necessarily outweigh other negative considerations. 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. It should be noted however that Ngolongozya Dam was constructed on a seasonal stream and therefore the downstream ecology is cut off from the overflow via the spillway in dry season. The downstream and upstream ecology survives on the water dambos existing in the riverbed. 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). UNOPS has further conducted a biodiversity assessment and prepared a BMP to enhance conservation of flora and fauna during and after the remedial works.
OP 4.37	Safety of the dam	This policy is triggered because the remediation works at the dam are necessary to ensure dam safety. The dam is considered a small dam because it has a height less than 15m.

		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.
OP 7.50	Project on International Waterways	The policy is triggered because the remediation of the dam site was not previously part of the IDSP umbrella, and Ngolongozya Dam is located on a tributary of the Zambezi River. Under the AF, IDSP has requesting for an exception to notification according to paragraph 7a[4] of the policy. The project qualifies for an exception given that works and activities would not exceed the original scheme, change its nature, or alter or expand its scope and extent as to make it appear a new or different scheme. The dam remedial works consist of strengthening and stabilizing existing dam embankments and completing and reinforcing existing spillways to ensure dam safety. The activities will not change the nature and scope of the existing schemes and will not increase the dam's existing capacity. Therefore, these remedial measures will not adversely change the quality or quantity of water flows to the other riparian users; and will not be adversely affected by the other riparian users' possible water use. Further, the sub-project also includes measures identified in this ESMP, which will help mitigate impacts on flows and water quality.

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.

[4] The following exceptions are allowed to the Bank's requirement that the other riparian states be notified of the proposed project: (a) For any ongoing schemes, projects involving additions or alterations that require rehabilitation, construction, or other changes that in the judgment of the Bank (i) will not adversely change the quality or quantity of water flows to the other riparians; and (ii) will not be adversely affected by the other riparians' possible water use. This exception applies only to minor additions or alterations to the ongoing scheme; it does not cover works and activities that would exceed the original scheme, change its nature, or so alter or expand its scope and extent as to make it appear a new or different scheme. In case of doubt regarding the extent to which a project meets the criteria of this exception, the executive directors representing the riparians concerned are informed and given at least two months to reply. Even if projects meet the criteria of this exception, the Bank tries to secure compliance with the requirements of any agreement or arrangement between the riparians.

- 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 safety.

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

The Ngolongozya Dam remedial works will be managed and implemented by the Ministry of Agriculture (MoA) 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 ten dams, including Ngolongozya 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 Ngolongozya am 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.

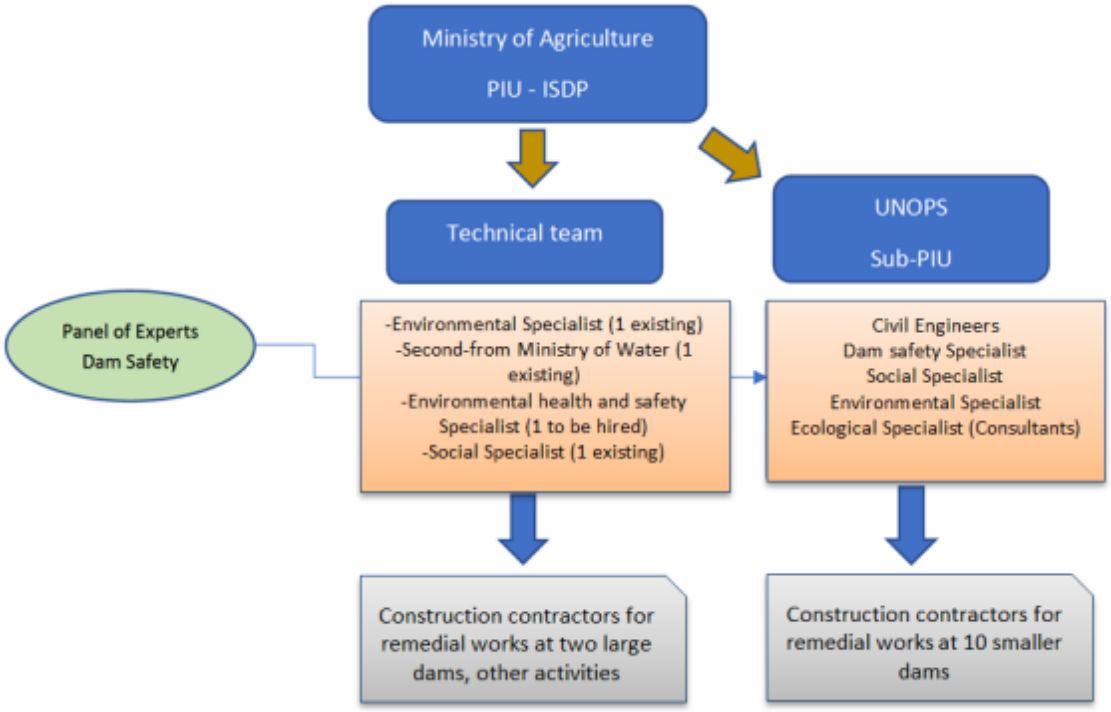


Figure 1 Institutional arrangement for sub-project implementation

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 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 for ensuring that environmental and social commitments for the Ngolongozya 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 Ngolongozya 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 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 MoA field staff member with health, safety and environmental responsibilities will be located at Ngolongozya Dam site for 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 Ngolongozya 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, dam committee and local communities, in preparation for 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 as well as advising the dam committee.

3.2 United Nations Office for Project Services (UNOPS)

The IDSP-PIU is contracting UNOPS to implement the remediation sub-project of Ngolongozya 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 including 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 Ngolongozya Dam site.

The environmental specialist, ecologist and the social specialist will be involved in the environmental and social management of Ngolongozya 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 Health, Safety, Security and Environmental (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 the ESMP, and will brief the Ngolongozya dam committee 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, gender based violence (GBV), stakeholder engagement, provision of flow during construction, environmental remediation and rehabilitation, maintenance and monitoring). This will be outlined in the procurement of the contractor. ESMP updates 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 personnel to the IDSP-PIU through the GRM which has been designed for the AF activities. The dam committee 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 dam committee, which consists of 5 women and 5 men, all community members. The Ngolongozya dam committee composition and positions are shown in Appendix F. The dam management committee is a locally developed, decentralised organisation where user communities have been ceded rights and have responsibilities for managing their own resources, typically using a mix of traditional or more formalised 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 involved during planning, and will be continuously active during construction and operation phases. Its role includes 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

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 Ngolongozya dam committee. In order to successfully operate the dam and limit impacts on people and environment, the dam committee members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; gender equality; health and safety issues, erosion control and conservation (see training plan below).

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

4. Environment and Social Baseline Conditions

4.1 Physical Conditions

4.1.1 Geology

The geology of the Ngolongozya dam site comprises of metamorphic (migmatites and gneiss) rocks. The upstream area mainly consists of granitic rocks from the Choma – Kalomo block. The rocks in this area are believed to be unweathered and to have low secondary porosity. The granite formation extends from the headwaters of the Ngolongozya catchment through the dam site up to the mouth of the Kalomo River. At selected sections, the site is characterized by rock outcrops, particularly on the upstream side of the site. These have become more exposed due to the removal of topsoil by the initial construction works and by natural events (Figure 2).

Figure 2 Exposed rocks downstream of the dam

The common soils underlying the area are leached. The Zambian soil map classifies the soil types of the province as predominantly acrisols, luvisols, lithosols and arenosols. The soils in the project area fall within this classification. Specifically Zimba District is characterized by sandy loam soils with scattered Kalahari sands and clay loams. The entire catchment of the dam site is covered by this. At the dam and downstream of the river, the soils appear sandy (Figures 3 and 4). Extensive tree cutting, due to poor catchment management and areas left open during construction show signs of erosion (open dam site area is approximately 15000m^2). These are located in the spillway channel, spillway boundary slopes and downstream around the rock toe and the whole area below the downstream embankment slope. A few areas, such as the upstream embankment are grassed and stone pitched. The location of these areas is shown in the land use map (figure 12).

Figure 3 Disturbed eroding slopes and former gardening area due to initial construction works exposing rocks

Figure 4 Stone pitched and grassed upstream embankment

4.1.2 Topography

The Ngolongozya dam catchment area has elevations ranging about 1100 m above mean sea level (msl). The highest elevations are in the north- and south-eastern part of the catchment of the dam site.

The other major sources of siltation and soil movements are the incomplete initial construction works and livestock watering points, which are around the basin and downstream (Figure 5). In addition, the D/S embankment does not have adequate grassing as it is suppressed by livestock watering and feeding. The crest is not vegetated due to vehicular and pedestrian activities.

Figure 5 Upstream livestock watering area with loose soil

4.1.3 Hydrology

The district is drained by the Zambezi, Ngwezi, Kalomo and Nalutabi rivers. It has several streams, which are mostly seasonal. The district has another 48 man-made dams, which are dotted all over the area, some of which can be seen on the land use map. The district has a poor history of ground water supply and is hence dependent on dams. Ngolongozya River is seasonal in character, but it contributes significant water flow to the Kalomo River, which drains the southern part of the district before terminating into the Zambezi River. According to Nyundu and Siwale (2014), Ngolongozya is an ungauged river with no historical records of water flow. They further state that the river has a catchment area of 89.4 km^2 (Figure 6) which is 1.4 per cent of the total catchment area of Kalomo River (6,309 $km^{2)}$. There are four small streams and two other reservoirs downstream of the dam flowing into the Kalomo River within a 1km radius. The three dams have downstream flow that forms confluences and contribute to the quantity of flows into Kalomo River[5] (Figure 7). The surface hydrology around the dam is shown in the Figure below (Figure 6).

[5] Flows were not measured.

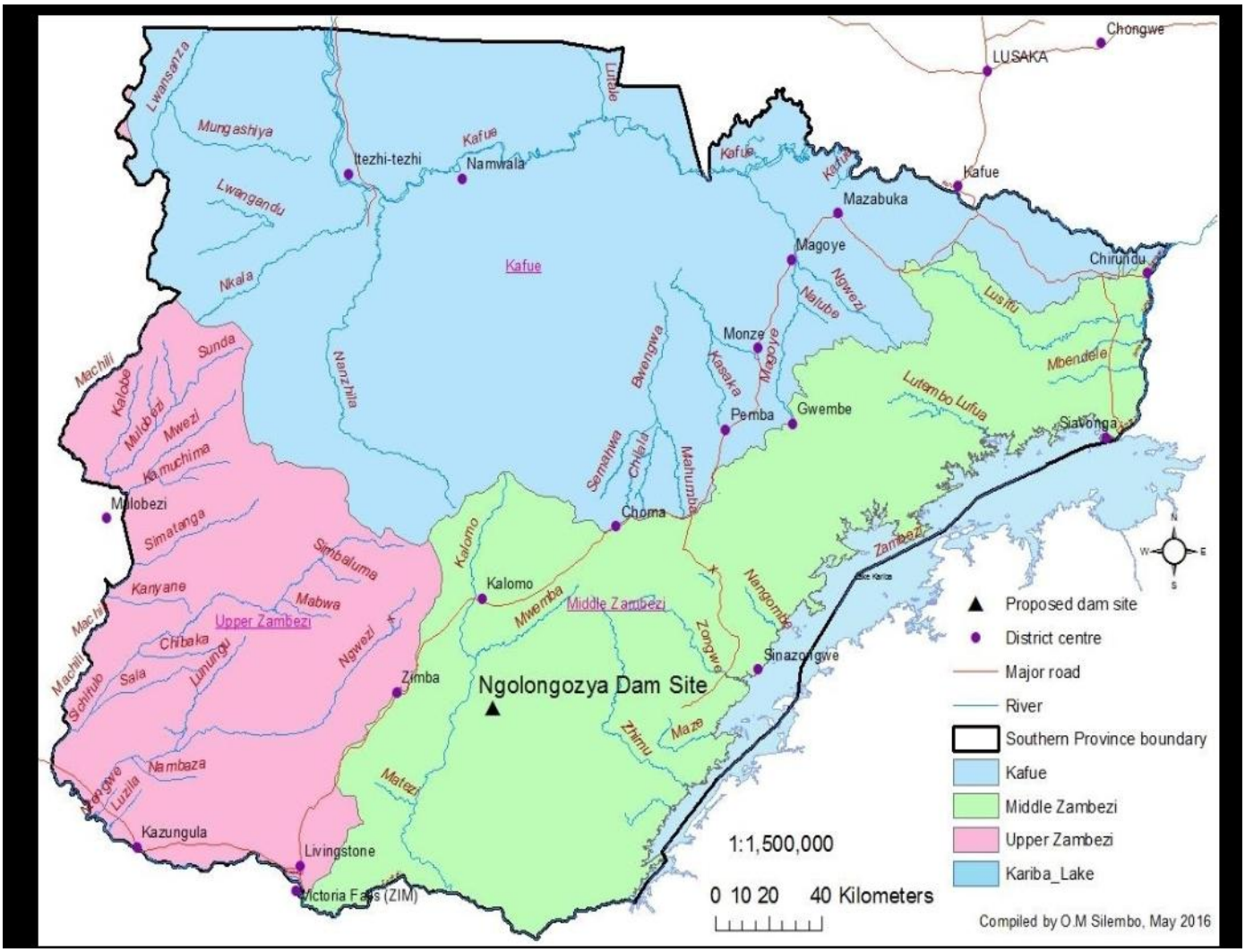


Figure 6 Map showing the dam location and the surface water resources around it[6]

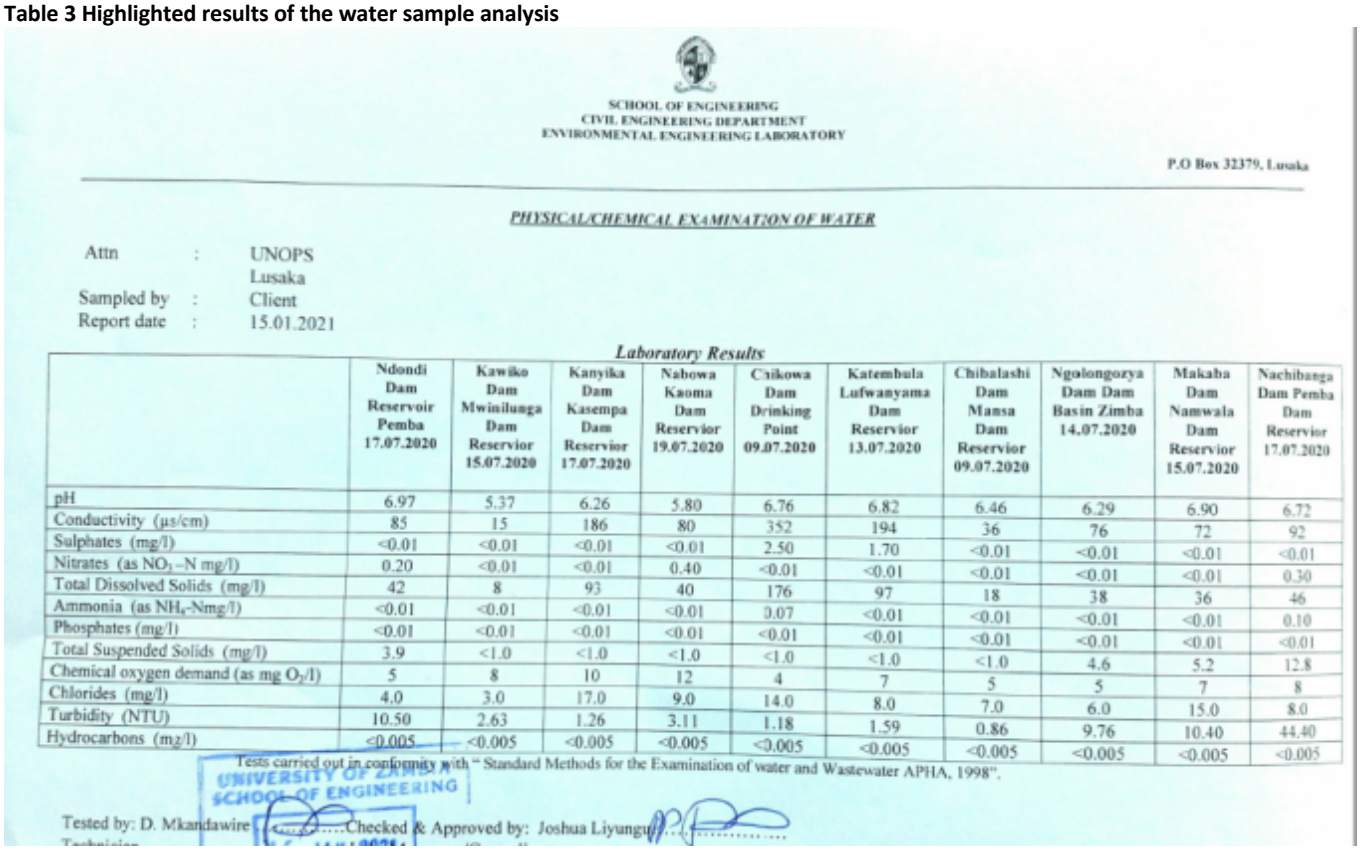
[6] Department of Water Resources Development: Environmental Project Brief, 2016

Figure 7 Streams, Ngolongozya and the downstream flows of neighbouring dams that combine and flow into the Kalomo River

4.1.4 Water Quality

Water samples were collected by UNOPS in 2020 upstream in the dam basin, coordinates 17°22'8.88"S; 26°32'26.68"E, and taken for quality analysis at the University of Zambia. Table 3 below shows the water quality at Ngolongozya Dam in comparison to other dams under the project.

Table 3 Highlighted results of the water sample analysis



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	3.07	<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

Tested by: D. Mkandawire ..... Checked & Approved by: Joshua Liyungu .....

Element	Analytical result	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[7][8]
pH	6.29	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	76	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	
Total Dissolved Solids (mg/l)	38.00	1000	
Ammonia (as NH4-Nmg/l)	< 0.01	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	4.60	-	50
Chemical Oxygen Demand (as mg O2/l	5.00	-	250
Chlorides (mg/l)	6.00	250	
Turbidity (NTU)	9.76	5	
Hydrocarbons (mg/l)	< 0.005	-	10

[7] 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.

[8] 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.

Comparing the analytical results of Ngolongozya Dam (Table 3) with the WHO guidelines on permissible levels for drinking water and with the World Bank Irrigation Water Quality Standards, the water quality generally meets the required standards. However, the turbidity level is still above the permissible drinking water levels.

The turbidity at the dam could be a result of the transfer of silt from the area within the dam site, given the open eroded areas left behind by the initial construction works, and the loss of soil due to overgrazing and cultivation. High turbidity in the dam reservoir may limit water use and negatively impacts the sustenance of the aquatic ecosystem due to potential limitations in photosynthetic processes.

A sample of the proposed contractor drinking water was collected from the local primary school borehole and tested at the University of Zambia Laboratory. Comparing the analytical results (Table 4) with the WHO and the guidelines by the Zambia Bureau of Standards on permissible levels for drinking water, the water quality generally meets the required standards.

Table 4 Water quality results for Ngolongozya primary school borehole, 2021

Element	Analytical result	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard
pH	6.29	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	76	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	
Total Dissolved Solids (mg/l)	38.00	1000	
Ammonia (as NH4-Nmg/l)	< 0.01	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	4.60	-	50
Chemical Oxygen Demand (as mg O2/l	5.00	-	250

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS
Lusaka
Sampled by : Client
Report date : 18.05.2021

Laboratory Results

Sample ID	Ngongolongozya School Borehole
Sampling date	**12.04.2021**
Parameter	
pH	7.55
Conductivity (µs/cm)	492
Sulphates (mg/l)	68.80
Nitrates (as NO_3 –N mg/l)	<0.01
Alkalinity (as $CaCO_3$ mg/l)	132
Total Dissolved Solids (mg/l)	146
Ammonia (as NH_4-Nmg/l)	<0.01
Phosphates (mg/l)	<0.01
Total Suspended Solids (mg/l)	<1.0
Chemical oxygen demand (as mg O_2/l)	2
Chlorides (mg/l)	21.0
Turbidity (NTU)	
Hydrocarbons (mg/l)	<0.005

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

Element	Analytical result	WHO Guidelines maximum permissible levels for drinking water
pH	7.55	6.5-8.5
Conductivity (µg/cm)	492	1500
Sulphates (mg/l)	68.80	250
Nitrates (as NO_3-N mg/l)	< 0.01	500
Total Dissolved Solids (mg/l)	146	1000
Ammonia (as NH4-Nmg/l)	< 0.01	1.5
Phosphates (mg/l)	< 0.01	-
Total Suspended Solids (mg/l)	< 1.0	-
Chemical Oxygen Demand (as mg O2/l	2.00	-
Chlorides (mg/l)	21	250
Turbidity (NTU)	-	5
Hydrocarbons (mg/l)	< 0.005	-

4.1.5 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. For Zambia, previously conducted studies on seismic hazard assessments estimate the Peak Ground Acceleration (PGA) (which is the maximum ground acceleration during an earthquake shaking at a location) between 0.3 to 0.9g[9] (equal to magnitudes 2.943 to 8.829m/s^2). This poses a very low risk. Only three major occurrences have been recorded in Southern Zambia between 1910 and 2016. Two of them took place around Lake Kariba and one in Southern Province (Table 5).

[9] g= Gram force 1g=9.81m/s^2

DATE	TIME	LAT	LONG	MAGNITUDE	REGION
13/12/1910	11:34	8	31	7.1	South Of Tanganyika
13/12/1942	13:40	11.4	34.5	6.7	Western
25/09/1963	07:03	16.73	28.4	6.4	Lake kariba
18/07/1986	15:07	16.36	28.48	5.4	Lake kariba
10/05/1991	01:12	17.35	24.98	4.8	sw of Mulobezi
13/02/2010	16:00	13.4	30.84	5.3	Serenje
18/01/2011	16:31	8.6	31.74	5.7	Mbala
21/07/2011	15:55	15.96	25.98	5.2	Itezhi-tezhi
02/10/2013	14:23	13.4	31.8	4.5	West of Chipata
3/11/2014	18:25	10.97	29.69	5.3	Lubwe, Luapula
19/08/2015	00:15	9.66	28.61	5.1	Luapula Province
09/01/2016	03:05	16.046	28.55	4.6	Lusaka & southern Provinces

Table 5 Major earthquakes in Zambia, Zambian seismic network country report, 2017

According to the US Geological Survey, the seismic hazard level is low around the area where Ngolongozya Dam is located. It is within the range of 0.4-0.8 m/s^2 (with 10% excess probability in 50-year PGA)(Figure 8)[10]. Unlike large dams, small dams do not induce seismicity.[11] Furthermore, historical data on the performance of previously studied dams shows that embankment dams perform well even under strong ground motions. Well-built and well compacted embankment dams improve dam safety and can withstand moderate earthquake shaking with a PGA above 1.96m/s$^{2.}$

[10] Zambian seismic network country report, US geological survey, 2017

[11] Tosun, Hasan, Earthquakes and Dams, 2015: https://www.intechopen.com/books/earthquake-engineering-from-engineering-seismology-to-optimal-seismic-design-of-engineering-structures/earthquakes-and-dams

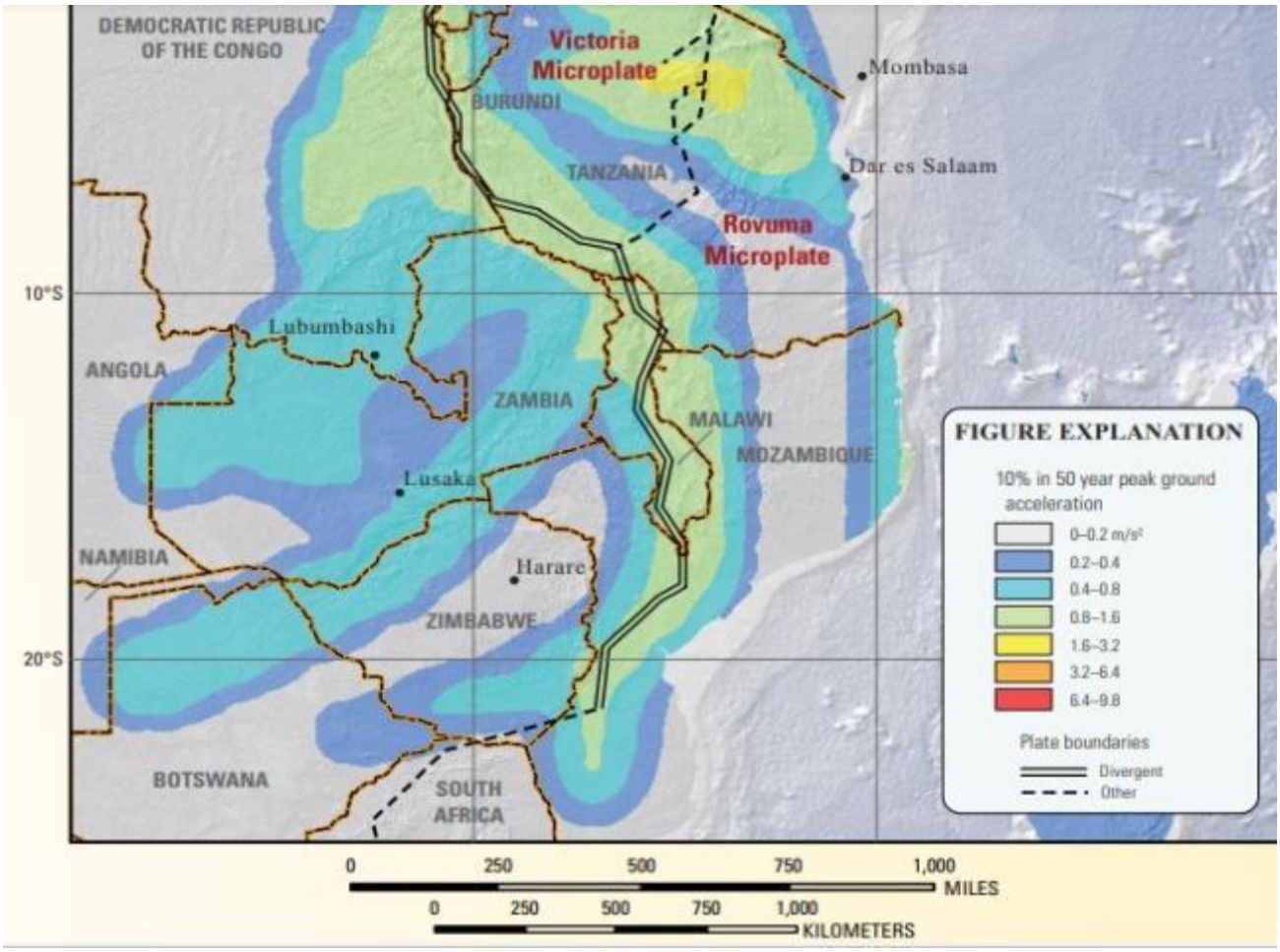


Figure 8 Seismic hazard in Zambia, US Geological Survey 2013

4.1.6 Climate and Climate Change

The climate in the Southern Province of Zambia can be described as humid subtropical, with dry winters and hot summers. Three distinct seasons can be observed:

- a rainy season - a warm wet season from October to May
- a cold season - a mild to cool dry season from May to August
- a hot season - a hot and dry season from September to November.

Rainfall: The Southern Province is located in the agro-ecological zone[12], which is characterized by an annual average rainfall of less than 800mm. According to data obtained from four Zambia Meteorological Department (ZMD) stations in Southern Province, the mean seasonal rainfall between October and May varies between 700 and 800 mm. The graph below shows values of average monthly rainfall and average temperatures for Choma, which is the nearest station to Ngolongozya Dam.

[12] These are 3 zones based on rainfall amounts in Zambia, but also incorporate soils and climatic characteristics. Zone I receives less than 800mm annual rainfall, Zone II receives between 800-1000mm of annual rainfall and Zone III receives between 1000-1500mm of annual rainfall.

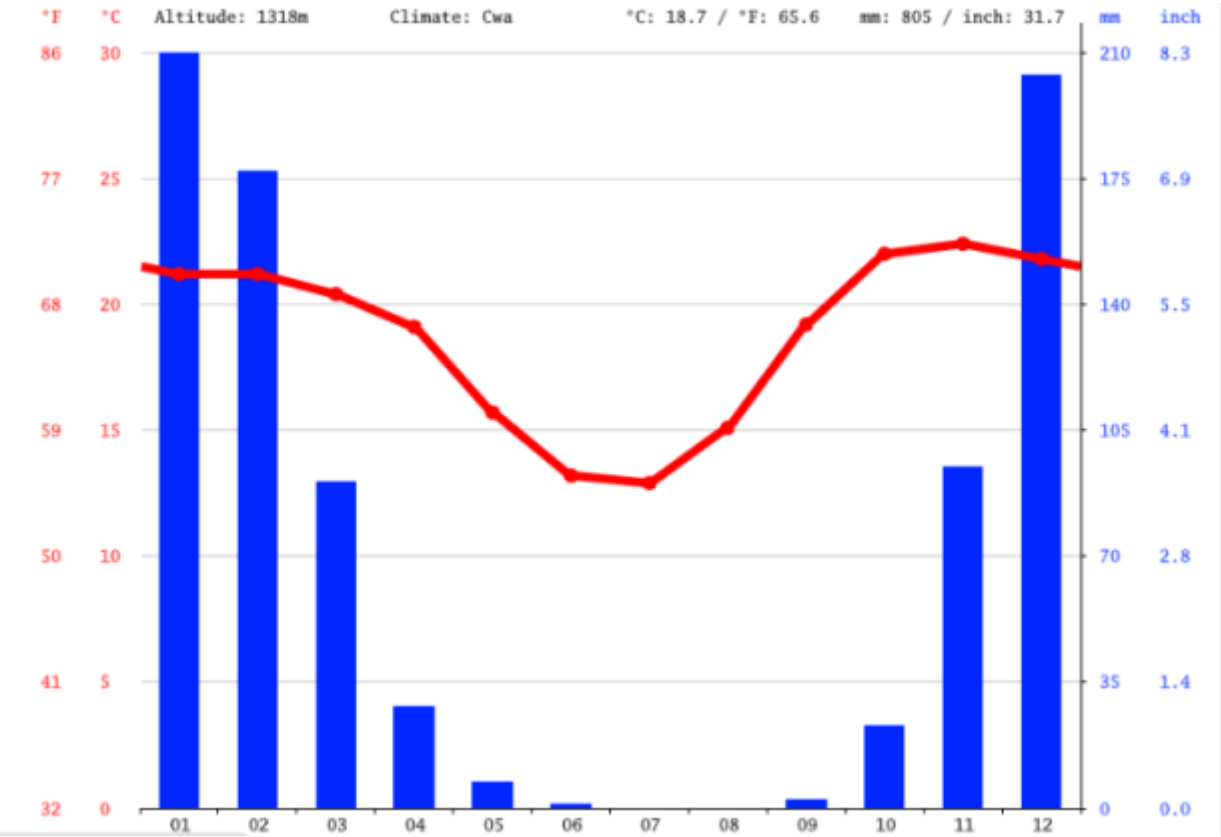


Figure 9 Average rainfall per month in Choma, Climate-data.org

Temperature: The mean annual temperature at Choma is 18.7°C. The average monthly temperature throughout the year is shown in Figure 10. The hottest month is November and the coldest is July.

Humidity: Zimba experiences a 10 year period average of 54% humidity and 37% cloud cover.[13]

[13] Zimba, Luapula, Zambia Weather Averages | Monthly Average High and Low Temperature | Average Precipitation and Rainfall days | World Weather Online

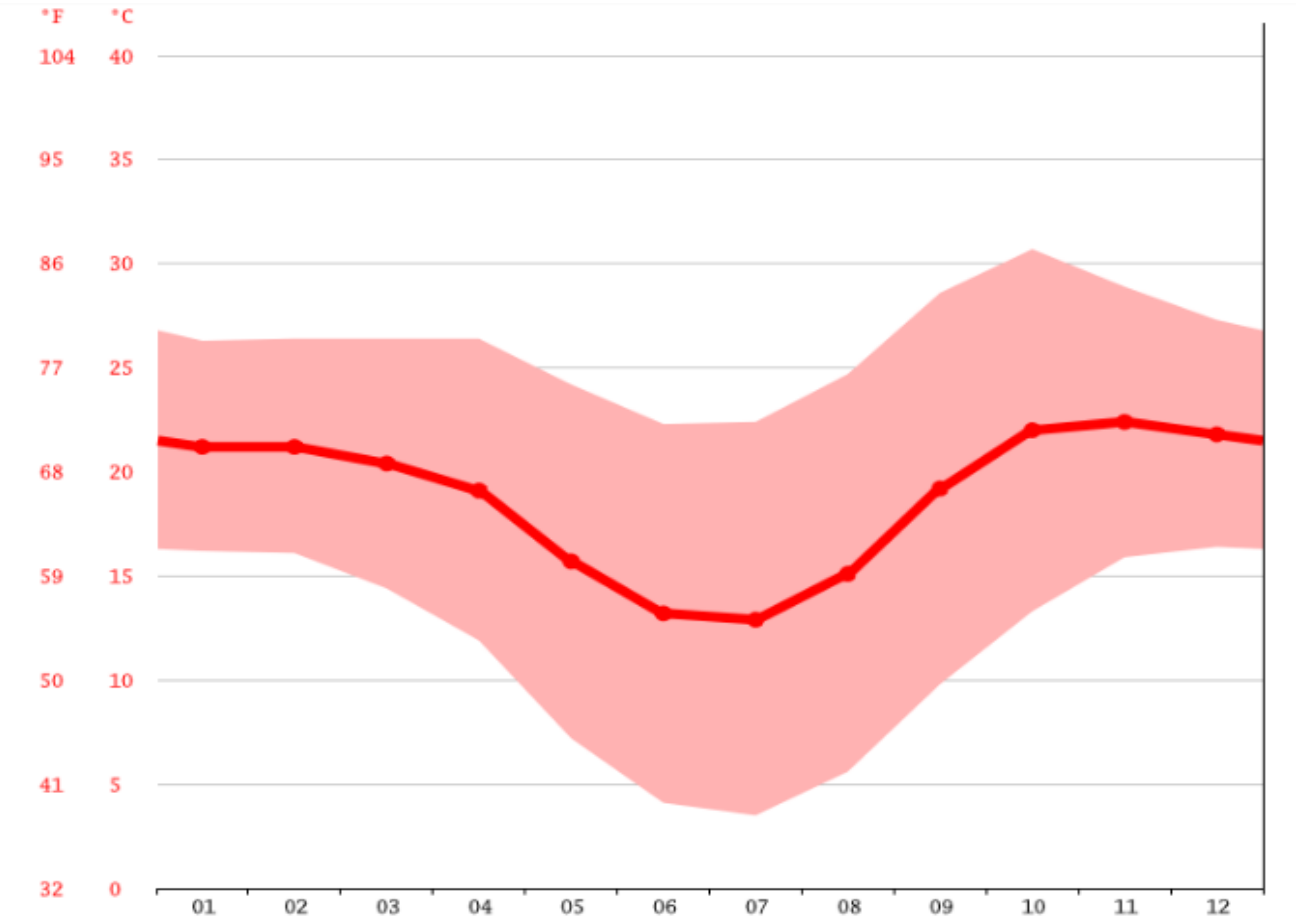


Figure 10 Choma average temperature per month, Climate-data.org

According to the World Bank[14], Zambia's climate is highly variable and in the last few decades it 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. Climate change has had adverse impacts on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty, these factors also limit economic development.

According to a study by UNDP[15] from 2008, climate change is set to increase food insecurity in agro-ecological zones I and II in Zambia. Agro-ecological zone I, which stretches along the southern border, has the least rainfall. Since the late 1980s, this zone has been subject to a tendency for a later onset and earlier withdrawal of rains, as well as more frequent droughts. In the last seven years of this decade, Zambia has had droughts in the rainy seasons of 2000/01, 2001/02 and 2004/5. Floods become more widespread too: over half of Zambia's districts were affected in the last few years – 2005/6, 2006/7 and 2007/8 being the most recent - some for the first time.

With very little infrastructure for water collection, Zambia is overwhelmingly dependent on rainfall. Water

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

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

needs are met through boreholes and wells, where available, or alternatively through rivers. The Ngolongozya Dam is 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. Agro-ecological zone I is already a marginal area for the cultivation of crops due to its low annual rainfall. 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 communities in Southern Province depend mostly on cattle for their livelihood.

Climate projections for Zambia[16] are shown in Figure 11, for which the World Bank used the Coupled Model Intercomparison Project, Phase 5 (CMIP5) models included in the IPCC's Fifth Assessment Report (AR5). Key projected climate trends are summarized below:

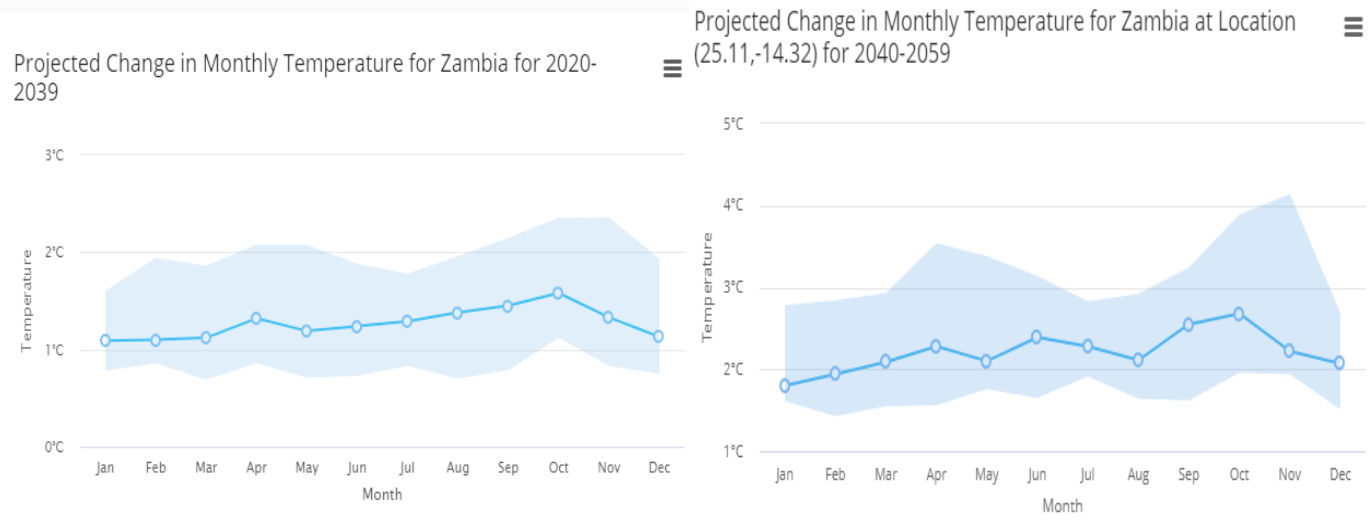
Temperature

- 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 large, but indicates decreases in September-November and increases in December-February rainfall respectively.
- The proportion of rainfall from heavy events is expected to increase.

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



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

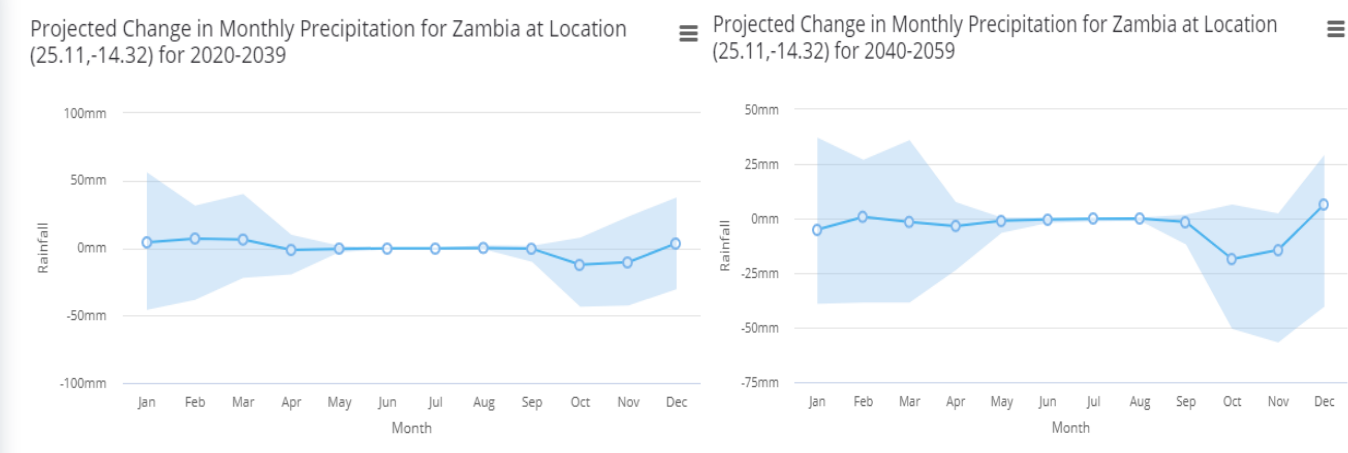


Figure 11 Projected changes in monthly temperatures for Zambia 2020-2059

4.1.7 Land Use

The main land use around Ngolongozya Dam is characterised by agriculture and rural settlements (Figure 12).

The proposed sub-project area mainly consists of traditional village settlements with small holdings. The land is considered traditional land, under the administration of His Royal Highness Chief Simwatachela. According to local and district-level sources, most of the village settlers stem from the people that were displaced during the construction of the Kariba Dam in 1958 in Lower Zambezi. The community is called the 'Zambezi/ Kariba Tongas'. The dam was supposed to improve people's livelihoods. However, it cannot be used due to the lack of the irrigation system.

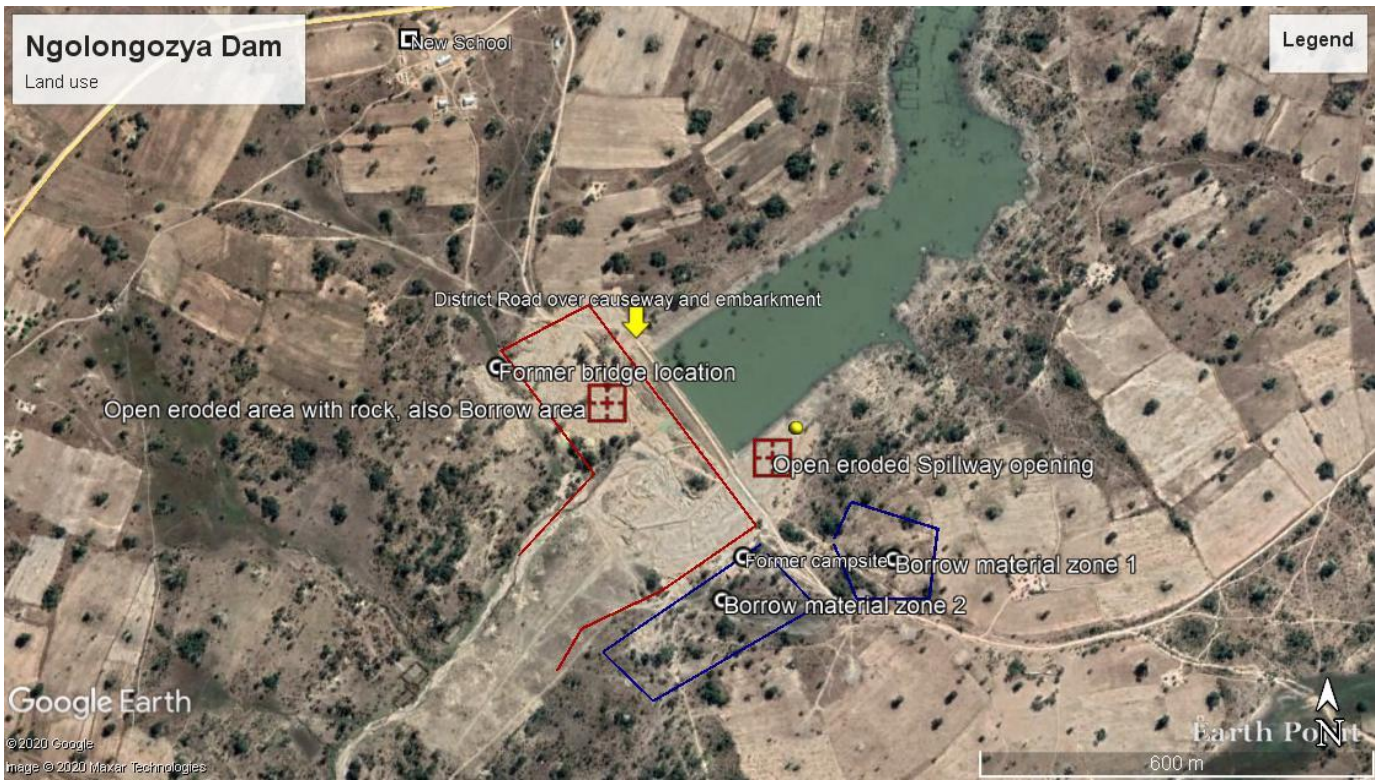


Figure 12 Google map of Ngolongozya showing neighboring infrastructure and sites that require rehabilitation

4.2 Biological Conditions

A detailed biodiversity assessment for Ngolongozya Dam was undertaken and a BMP prepared.

4.2.1 Terrestrial Flora and Fauna

Ngolongozya Dam is situated in a heavily settled rural area. Habitats have been modified significantly by dam construction works, cultivation, bush clearing for charcoal and firewood and overgrazing (Figure 13).

Figure 13 Sparse vegetation due to bush clearing around the dam

Mopane and Miombo woodlands are the predominant type of vegetation in the sub-project area, with scattered elements of munga woodland dominated by *Acacia, Terminalia spp* and *Combretum*. The terrestrial species of conservation concern within a 50 km radius of the dam, listed by the IBAT, are unlikely to occur within the direct area of influence of the dam, where habitat loss is extensive. In view of the dam's impact on the aquatic environment, the site may be important in supplying water to downstream systems draining into Lake Kariba, in which Green headed bream- *Oreochromis macrochir (VU),* Three spotted tilapia-*Oreochromis andersonii (VU) and* Kariba tilapia-*Oreochromis mortimeri (CR)* are present. A detailed biodiversity assessment has been undertaken and the results will be presented in a different document.

If its area of influence, the stream is split into 3 parts:

1. Most vegetated
2. Least vegetated
3. Less vegetated

A forest cover analysis is shown in the Map below.

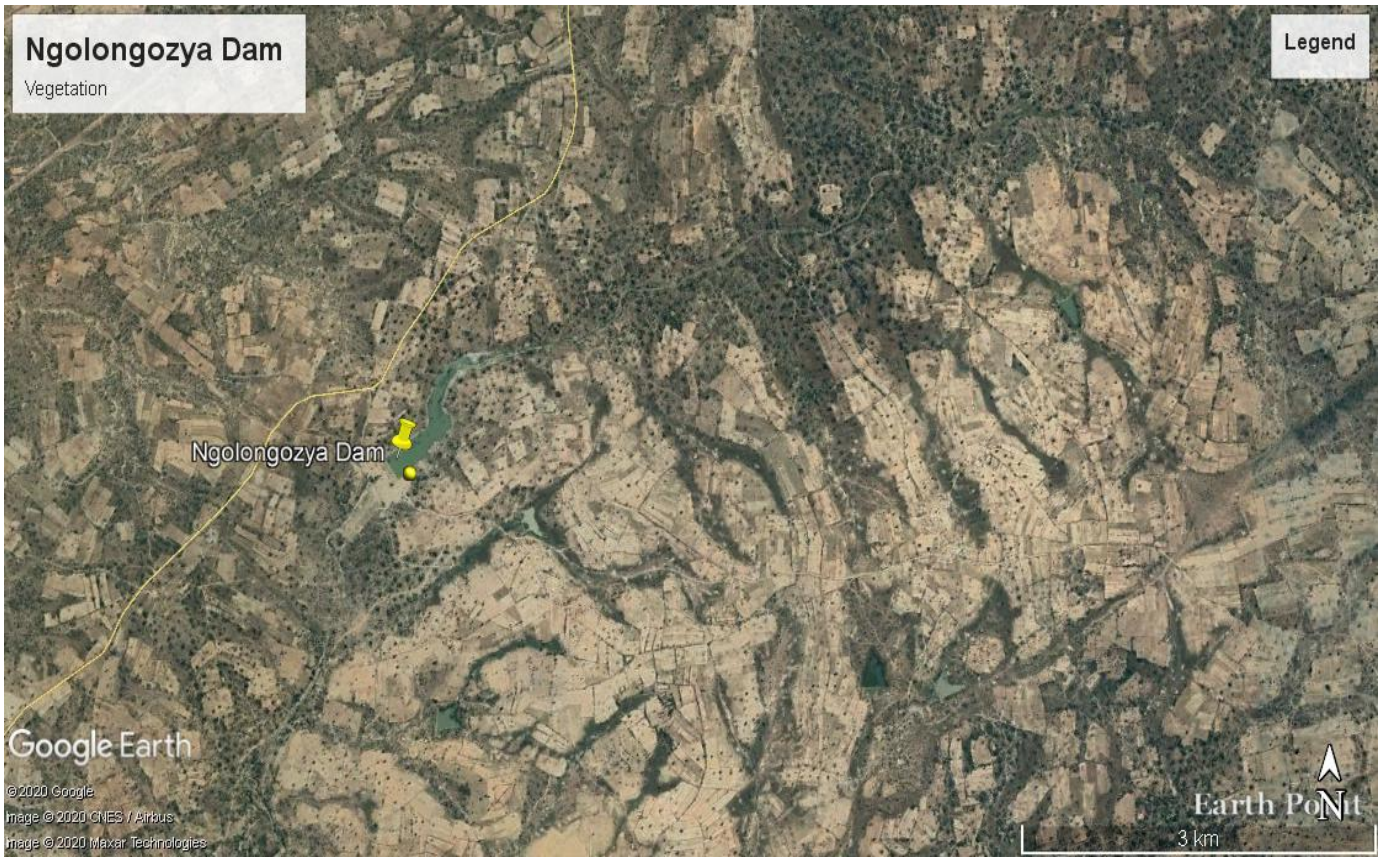


Figure 14 Vegetation distribution in the area of influence of the dam

The downstream area (Part 3) is less vegetated than the upstream (Part 1). Comparing the 3 parts of the stream, vegetation distribution is sparse with regenerates within the basin area (Part 2). The dam site is deforested and open as a result of construction activities. The vegetation around the basin (Part 2) is illustrated in Figure 15 below:

Figure 15 The current dam basin vegetation regeneration after construction works vegetation clearing

The avifauna species in the area, as confirmed by the local communities, are shown below[17]:

Table 6 Avifauna confirmed by the community at Ngolongozya Dam

Common Name	Scientific name	IUCN Status and Species of conservation concern
Birds		
Squacco Herons	*Ardeola ralloides*	LC
Yellow-Billed Egret	*Ardea brachyrhyncha*	LC
Black winged stilt	*Himantopus himantopus*	LC

4.2.2 Natural or Critical Habitats

Zimba district has one gazetted forest, which is the Zimba Hills P10 local forest, with an estimated total land area of 18,800ha. This forest is located about 40 km south-west of Zimba town, along the Nyawa road. It is not located in the sub-project area.

[17] These are detailed in the annexed BMP.

4.2.3 Aquatic and Semi-Aquatic Fauna and Flora

Fishing in the district is mainly related to aquaculture development. Three types of bream species are cultured, namely the Three spotted bream (*Oreochromis andersonii*), Red breasted bream (*Tilapia rendalli*) and Green headed bream (*Oreochromis macochir*). A few native species were observed at the dam site. The few confirmed existing aquatic species in the Ngolongozya Dam, as confirmed by the site assessment, authorities and communities are shown below[18]:

Table 7 Aquatic Species of the Ngolongozya Dam

Common Name	Scientific name	Species of conservation concern
Aquatic species		
Green headed bream	*Oreochromis machrochir*	VU
Barbel Fish	*Clarias gariepinus*	LC
Freshwater crabs	*Potamonautes*	LC

4.3 Social Conditions

4.3.1 Social Conditions Around the Dam

The Ngolongozya dam site is located in Zimba District, about 36 km from the Zimba urban center. Zimba District consists of one constituency (Mapatizya) and seven wards (Zimba, Chidi, Luyaba, Mulamfu, Mbwiko, Simwatachela, and Siamafumba). It consists of 13 headmen upstream and 8 headman downstream, with app. 78 households per headman. The total population of Zimba District is 13,284 households; 66,625 persons, (32,186 male and 34539 female). The population density is 16.9% per square kilometer, with an annual population growth rate estimated at 2.9%.

The dam community is called the 'Zambezi/Kariba Tongas', who were displaced from the Kariba dam works into the current area. Particularly vulnerable groups are female-headed households, chronically ill persons, aged and disabled persons.

Subsistence farmers (crop and livestock) make up most of the population and dominate the district's economy. The communities directly around the dam are also subsistence farmers, growing crops such as maize, groundnuts, sunflower, cowpeas, beans and sweet potatoes. Furthermore, most families rear livestock (cattle, chicken, goats and sheep). Only a few people are engaged in formal employment, mainly as teachers, agricultural or health workers and NGO staff. The largest employer is the government, and some people are employed on private mines and farms.

The main land use around the dam includes households, gardens, fields and roads. Individuals own private lots. . Allocation procedures are the same for everyone. Gardens are fenced against livestock, which is destructive when it is feeding or drinking – using tree branches, which are replaced annually.

Furthermore, the district has 10 health facilities, including a mission hospital, 8 rural health centers and one health post. 63 learning institutions are located in the district. Siamoono School has 226 enrolled students and is the closest to the dam site. Campsite housing from the previous construction work still exists.

[18] These are detailed in the annexed BMP.

The communities have easy access paths to the dam. A challenge, however, is that the main road is used by people and vehicles (district road Kalomo, Mapatizya to Zimba) and crosses the embankment and spillway. This road is steep towards the end of the spillway from the embankment. It is challenging for the old, pregnant women and for children, who use it on a daily basis. When it rains, it can be impossible to cross for a week. Since the school and health post are on the other side of the dam, for many community members the crossing of the dam is necessary. The road is narrow on the embankment and spillway causeway platform. The crest allows for one vehicle at a time, and reversing is a challenge, especially with the steep spillway platform. Some accidents have been reported on this district road. On average, 8 cars and 20 pedestrians cross over the embankment per hour; the number of cars and pedestrians increases in the morning (school pupils and town centre bound traders) and evening. The said road requires rehabilitation before and after the dam. It was the contractor's route and was in a better condition before construction works. The same road had a bridge where the embankment is (right side). However, it has been buried by sand due to construction activities. The road was diverted to the embankment top which is narrow with water overtopping concerns. The community prefers using the old bridge access point compared to the embankment/spillway for safety.

The dam was not constructed with canals. The communities would like to engage in irrigation activities for livelihood improvement. Downstream further from the dam, people use buckets, wells in the river bed as barely any water goes downstream after the cold season. Some women and children therefore find irrigation challenging, and disabled persons do not have gardens for this reason. The dam is not sufficiently used, as there is no irrigation system in place. Initially it was communicated to the communities that irrigation will be the main use of the dam, and the communities are still waiting for the irrigation facilities.

Current dam use includes livestock watering, upstream gardening with the use of buckets, wells in downstream riverbed, drinking water, dip tanks, brick making, construction of buildings (e.g. a new school is being built, using pumped water lines about 200m from the basin). Dam water is used as domestic supply water with reticulation pipes, as the community has water challenges. Some community members walk 8Km and carry water in buckets on their heads (women), on bicycles or in ox carts; in some cases they do so two times a day.

There is no more wood for energy sources in the area due to deforestation. Communities are not allowed to collect wood from neighboring villages.

4.3.2 Administration of Water and Dam

A dam committee is currently in place. It consists of 5 women and 5 men, who meet on a monthly basis. Together with the headmen it is tasked to conduct the monitoring and sensitization around dam issues. The committee has prepared rules, which it regularly communicates to the dam users. The implementation of the rules, however, has been postponed as the community suggested that the dam is not operational and construction is incomplete. The dam has no security measures in place except for the dam committee constitutional regulations, which have been adhered to so far.

Strengthening and capacity building of the existing committee can ensure that communities can benefit fully from the irrigation water supply. Similarly, beneficiaries would benefit from increased training to improve their knowledge on irrigation agriculture and promote income generation.

Training needs include siltation, drying of streams, nurseries, woodlot establishments, grassing techniques, forest protection and management, bee keeping and ownership of forests.

4.3.3 Gender Equality, Gender-Based Violence and Sexual Exploitation & Abuse

In the Ngolongozya dam communities, respondents during the field visits claimed that women generally don't find employment similar to men. Men mostly participate in income generating activities, including direct employment. However, they are able to work and get involved in dam activities. They are very engaged in farming activities and sell their produce in Zimba or Livingstone. Women are generally more involved in gardening than men. Some women are organized, for example in the Zambezi Group Women Club, which is active in livestock rearing. However, they don't have 'club gardens, as there is insufficient water for irrigation.

Gender-Based Violence (GBV) exists among the dam communities, but it 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.[19] 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.[20] Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[21] 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.[22] 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.[23]

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.[24] 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

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

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

[21] 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.

[22] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.

[23] Ditto, p. x

[24] Ditto

telephone counseling service).[25] 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.

GBV reports in Zimba can be filed with the Police's Victim Support Unit VSU, and the Government Community Development Unit deals in gender matters in the district. There has been no local initiative or GBV program.

4.3.4 Cultural Environment

For the development of this ESMP, stakeholders were consulted, including the members of the Ngolongozya dam management committee (DMC), dam users and district stakeholders (District Commissioners, representatives from Social Welfare Department, Arts and Culture Department, Forestry, Agriculture). Consultations were held in regards to the upstream and downstream communities 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 from the dam site. No potential cultural environment and cultural heritage impacts are therefore expected as impact of the proposed works and the operational phase.

In case chance finds occur during construction activities, chance find procedures are attached to this ESMP (see appendix B).

[25] Chidoori Rumbidzai, 2011, p. 32

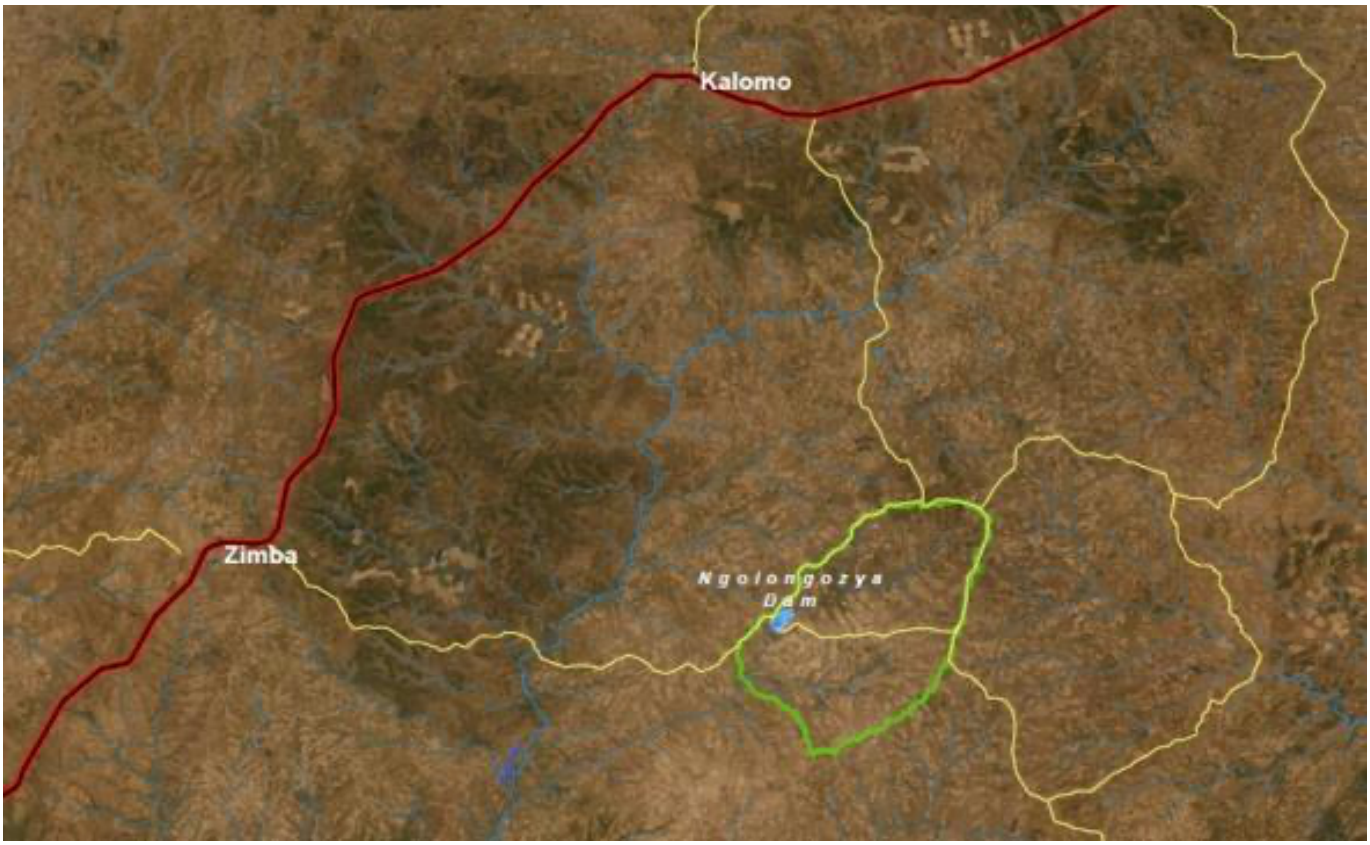


Figure 16 Schematic consultation coverage, 8Km from the dam mostly in the Zambezi Tonga region

5. Sub-Project Characteristics

5.1 Dam Characteristics

Ngolongozya Dam is an earth fill dam that was constructed in 2016 under the WRDP. It is located along the Ngolongozya River in Zimba District, which drains to the Kalomo River (location reference: -17.368394°; 26.539848°). The location is shown in Figure 17. The site is about 36 km from the Zimba urban centre, off the T1 road. The main purpose of the dam was to improve aquaculture, irrigation and stock watering. The dam was further subjected to an emergency raising of the wall by a further 1.5m in order to avoid overtopping. The dam wall crest has been 5m to accommodate light traffic across the wall since the initial construction works. The main dam characteristics are shown in Table 8.

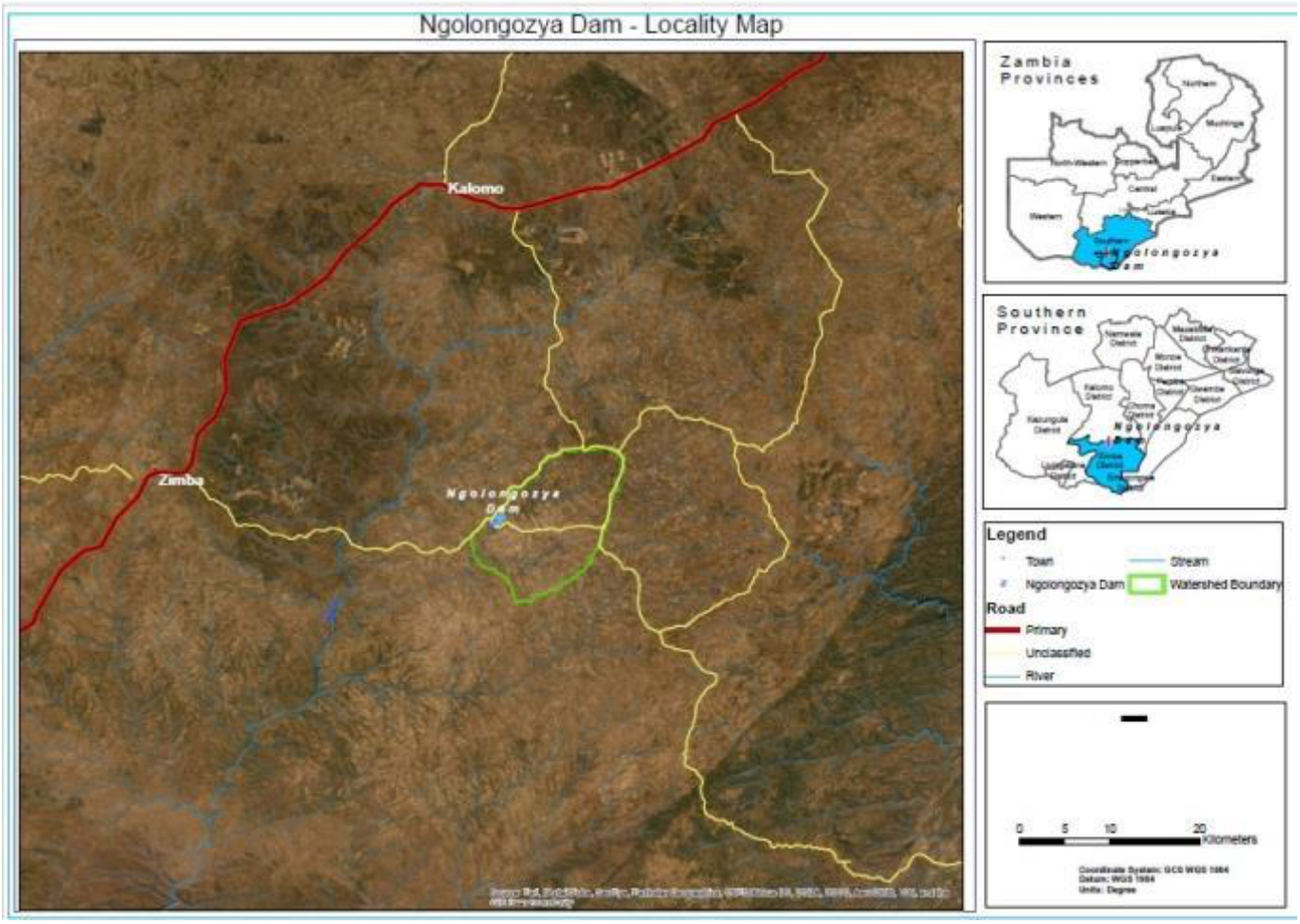


Figure 17 Google map showing location of Ngolongozya Dam in relation to Zimba Town and the T1 Road, UNOPS Design Report 2020

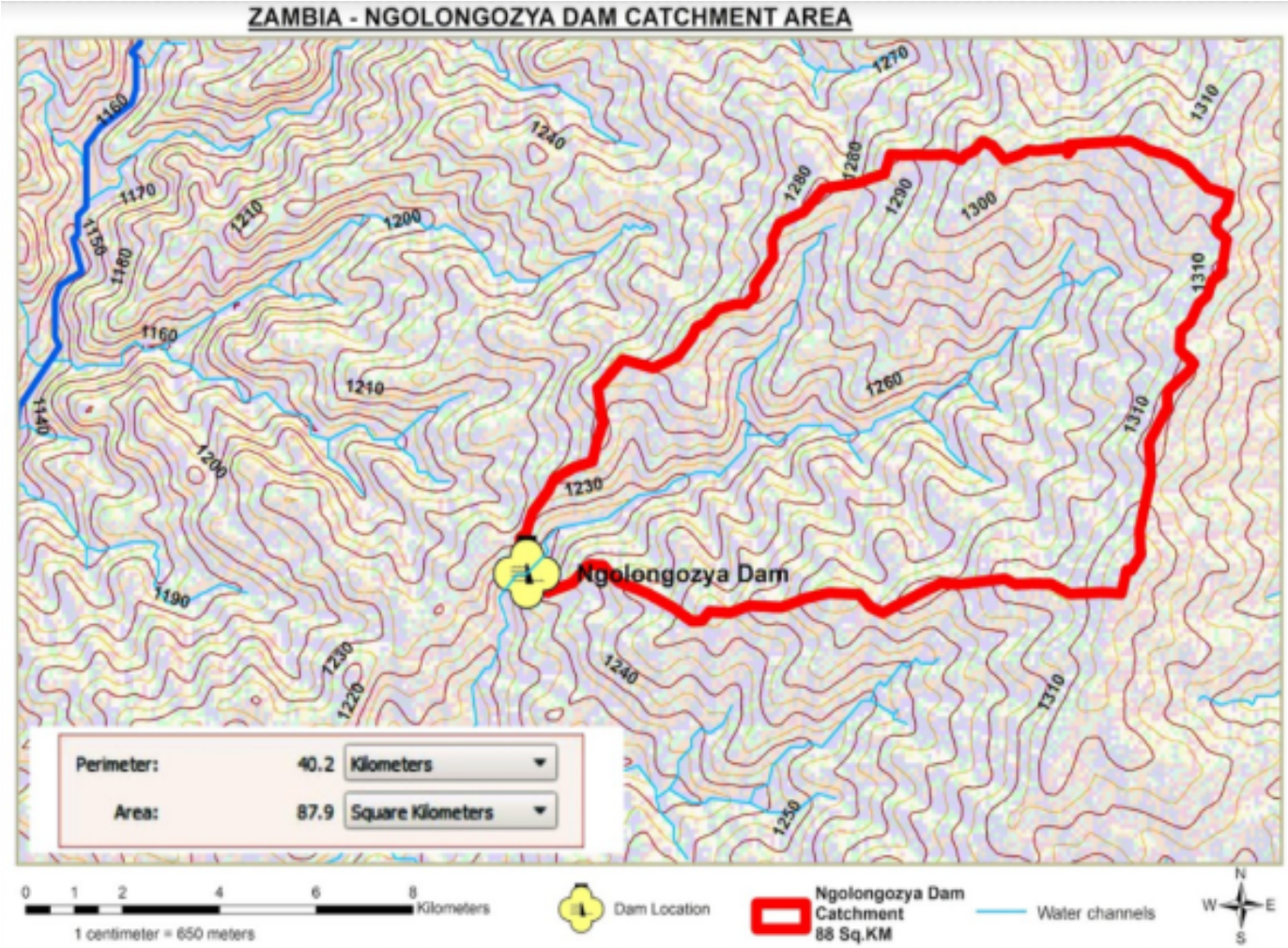
Table 8 Main characteristics of Ngolongozya Dam

Dam Catchment Data

Catchment Area:

Source Document	Year	km²	Method of Calculation
Ministry of M E & WD	2013	97.7	Not known - initial design work
COWI (initial report)	2018	97	Ministry of M E & WD figures
COWI - Aurecon	2018	89.41	From survey undertaken in 2018
Ministry of Agriculture	2020	89.4	Taken from COWI - Aurecon submission
UNOPS	2020	87.9	STRM 3D DEM (NASA) and ArcGIS

For calculation purposes for the remedial design works, the UNOPS 2020 value of 87,9km^2 for the *catchment area* has been adopted.



MAP, MAR, Inflow

The Mean Annual Precipitation (MAP) for this area is 710 mm.
The Mean Annual Runoff (MAR) for the area is 70 mm.
The MAR used is in accordance with the Zambia National Water Resources Master Plan (the Imagen Hydrological Consultants on the Luezi Dam near Zimba in 2014 calculated a MAR of 70mm per year runoff).

Based on the above data, the ***average annual inflow*** at the dam site is 87,900,000 * 0.07 = **5,274,000m³**

Dam Capacity

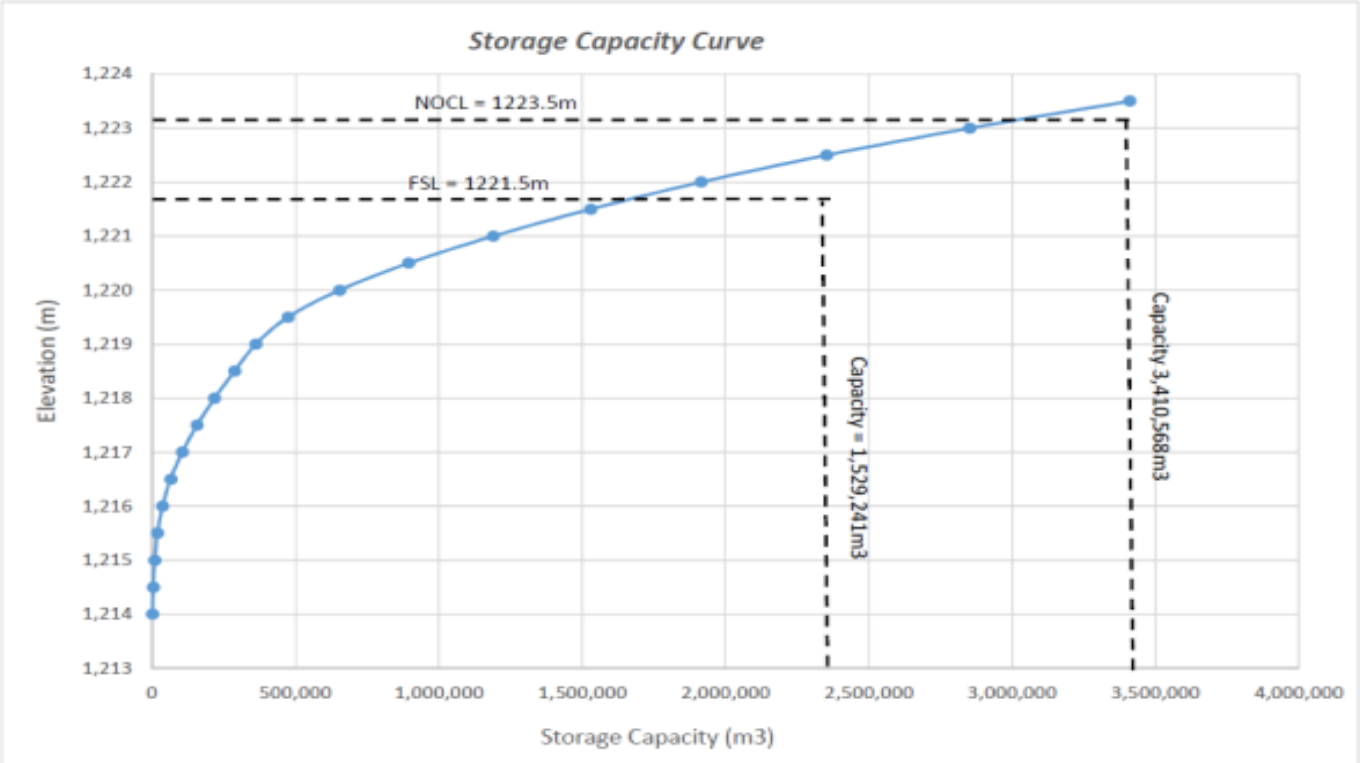
Source Document	Year	m³	Method of Calculation
Ministry of M, E & WD	2013	936,413	Desk study
COWI - Aurecon	2018	1,529,241	Full basin survey - topographic, UAV and bathymetric

For calculations, the 2018 value of **1,529,241 m³** has been adopted.

Assuming a 70mm MAR, the average annual inflow is	5,274,000 m³
Current estimated capacity of the dam is	1,529,241 m³

The site has been developed to only **29.00%** of its capacity. This is **3.45** times the current dam capacity.

The Depth - Capacity Curve for the dam is as follows (COWI, 2018):



Sedimentation

The catchment area is 87.9km^2 and assuming a sedimentation yield of 5000ppm (a poorly conserved catchment) with an assumed 100% trap efficiency of the dam, the dam will lose approximately 33,000m^3 of water per year or approximately a third of the storage in 15 years.

Geotechnical Investigations:[26] regarding the Atterberg Limits Result, all the materials sampled were CL i.e. sandy silts. As a rapid guide in assessing the suitability of soils for shoulder material, reference is made to the Plasticity Product (PP). If the PP is above 600 it is considered suitable as a core material. Shoulder material is considered good between 400 and 200. Lower than 200, it is either very coarse, but still usable depending on the grading. The results below indicate that the samples are predominantly silts and not ideal material.

Sample	**Plasticity Index (PI)**	**% passing the 75 µ**	**Soil Classification**	**Plasticity Product (PP)**
1	11%	10%	CL	110
2	12%	10%	CL	120
7	10%	17%	CL	170
Retest	13%	15%	CL	195
8	15%	17%	CL	255

However, observations show that the embankment is clearly made up of the tested material, which although not ideal has not exhibited any signs of slope failure.

[26] The purpose of the limited geotechnical investigations was to primarily assess the materials used in the construction of the embankment and to assess the quality or consistency of the compaction in the embankment. In addition it was to assess possible borrow materials for possible remedial works.

Embankment Crest and Slopes

Embankment Slopes: The embankment slopes as per the original design drawings from 2013 were given as 3:1 on the upstream and 2.5:1 on the downstream, with a crest width of 5m. Checks carried out at the cross sections, taken from the recently completed survey of the embankment, show that the portion of the upstream slope above the current FSL and the downstream slope are generally in compliance with the design - with the exception of a steeper slope on the top 1.5m of both faces to the crest of the embankment.

This change of slope is due to a localized raising, which was carried out during the rains in 2017 in an effort to increase the freeboard. At that time it had become clear that the spillway was potentially insufficient for the floods.

This localized raising resulted in the embankment crest being reduced to an average of <3.5m wide as opposed to the initial 5m. The 5m crest width is needed to provide the minimum width required for limited wheeled traffic. There are no obvious alternative crossings in the vicinity of the wall.

Embankment Crest: The embankment crest is extremely narrow – only 3m wide in some places. This is a result of the raising of the embankment crest by ca. 1.5m, which was done as an emergency measure to increase the freeboard and prevent overtopping – with no further material being placed on either the upstream or downstream slopes. The problem has mainly been exacerbated by the breakaway of the upstream crest, but also sections of the downstream crest, caused by cattle walking on the embankment. The surface is uneven and shows evidence of some rutting due to the use of vehicular traffic to cross to the left bank of the river (figure below shows the narrow crest).

The current crest level varies in height and needs to be investigated in conjunction with the redesign considerations of catchment area, hydrology and spillway size required to establish whether it gives adequate freeboard for the chosen return period storm.

Embankment crest

Front Face: The front face appears to be in reasonable condition and the slope from the current waterline to the original crest – before the emergency raising – appears in line with design slope of 3:1. This, however, steepens significantly from this point up to the current crest. The suitability of the front face slope will be confirmed by the resurvey exercise recently completed (see figure below).

Right hand end of causeway from downstream showing undercutting

Spillway undercutting viewed from upstream – no cut off constructed

As the embankment is used as a vehicular access route to the communities on the left bank of the dam and river, there has been no rip-rap protection placed around the left-hand end of the embankment to facilitate vehicle traffic (see figure below).

Spillway left-hand end of main embankment

The left-hand end of the spillway sill/causeway similarly does not have a substantive abutment but merely exits onto an earthen ramp up the left bank of the spillway channel.

Spillway Inflow Channel: The spillway inflow channel has effectively been excavated into the left bank of the river valley. This is a revision of the original design which had the main spillway on the right bank. The revised design had the excavation of the level inlet channel extending back into the dam far enough to provide a clear path for storm water flowing into the dam to pass freely to the spillway (refer to figure below).

Inlet channel to spillway sill and causeway

However, there is a large outcropping of rock in the center of the inlet channel, which effectively reduces the width of the spillway and at the same time directs a lot of the flow towards the training wall - forming the right-hand side of the spillway discharge channel (figure below).

High spot in inlet channel - taken from causeway

Spillway Return Channel: As with the spillway inlet channel, the spillway discharge or return channel has been excavated into the left bank of the river valley to achieve the desired relatively flat floor width of 60m. The right bank of the return channel comprises an earthen training wall extending from the left-hand end of the embankment to close to the channel exit to the riverbed. There are also two concrete drop structures in the channel, which were designed to regulate the flow down the length of the channel and prevent major erosion and the formation of gullies cutting back to the main spillway (refer to figure below).

Aerial view of spillway return channel

The Training Wall has been subjected to severe erosion since the first spilling and there was a complete wash away of a portion of the wall in 2018, resulting in the formation of a new return channel back to the river fairly close to the embankment. The resultant siltation from this new channel subsequently caused the formation of a large pool at the base of the embankment. The washed away section of the training wall was repaired, and the original return channel reinstated. Subsequent floods have further damaged the repairs but not to the extent of a new breakthrough.

The subsequent floods passing in 2019 have further seriously eroded the training wall further down its length and the damage is almost to the point of total wash away (refer to figure below).

Spillway channel showing 2018 breakthrough channel and 2019 damage

The drop structures have both been severely damaged by the passing floods and the attendant gullying that has taken place in the channel. This has left both structures completely washed away along their intersection with the training wall and badly undercut along other portions of their length (refer to figure below).

Drop structure complete washout and undercutting

The erosion and gullying that has occurred along the channel floor has exposed how badly these structures were built initially and show that the structures bear no relation to the drawings in the original design.

Secondary Spillway (Emergency Spillway)

The original design and construction drawings issued for the Ngolongozya Dam had the spillway and return channel off the right-hand end of the embankment. This was changed to its current location during construction when it was found the ground conditions were not good and the left bank had much better conditions for a spillway.

During the 2018 rains high flood event, an emergency spillway was opened up on the right bank –at the same time as the emergency raising– to prevent possible overtopping of the embankment. This caused some gullying close to the embankment as the water made its way back to the river - as there was no effective return channel constructed to direct the water further downstream of the embankment before returning it to the river. To prevent the gullying cutting back to in front of the embankment it was temporarily repaired with the use of sandbags (refer to figures below).

Secondary spillway as cut in 2018

Secondary spillway gully and temporary repairs from 2018

Flood Design

A 1:100 year flood of 159.8m^3/sec was used in the original design. It is not known what method was used in obtaining the design flood used in this initial design.

The adopted Design Criteria for this sub-project is based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods have been checked in comparison with results obtained from the VKE and Pitman.

Based on the design criteria and current surveys the below is a summary of the spillway details:

Catchment Area.	88 km2
Max Probable Flood	888 m^3/s
100 year Flood Estimate	400 m^3/s
Fetch	0.65 km
Dry Freeboard	0.450 m
Service Spillway Width	53.0 m
Current Crest Level	1222.1 m
Spillway Level	1220.0 m
Current Freeboard	2.090 m
Coefficient of Discharge	1.6
Estimated Raising Required	1.20 m
Total Freeboard Required	3.29 m
Revised Crest Level	1223.3 m

Riverbed Level	1214.0m
Height of Dam	9.3m / max 6m depth of water

The design flood adopted requires an increase in the current freeboard of **1.2m** or a large increase in the spillway width to **190m**.

Outlets: There are two 300mm steel pipe outlets located on the right and left banks of the main wall. The left bank outlet was to serve an irrigation block but this seems to have been abandoned as the return channel and subsequent breaching of the training wall have made the irrigation block inaccessible.

It is however used as an emergency discharge during periods of high flood and this has washed away the valve chamber structure and created a large wash area that will need to be repaired. The right bank outlet is blocked.

Outlet Pipes Through Embankment: There are two outlet pipes through the embankment, a *low flow pipe* to ensure environmental flow in the river downstream and an *irrigation supply pipe* to supply water to the canal for servicing the arable area on the left bank of the river downstream. The *low flow pipe* terminates in a concrete valve chamber which appears to be in good condition as with the valve inside. However, it appears that the intake chamber at the upstream end of the pipe in the dam has been blocked during filling with a board and currently the pipe is unable to release water from the dam.

An aerial view of the pipe and valve chamber show there has been a shift of the pipe and chamber towards the lowest point of the dam. If this is the case, and there is the possibility of the pipe fracturing it could cause major problems later when the blockage is removed at the upstream end and water can flow freely in the pipe as there would be no means of stopping it until the dam was empty (refer to figure below).

Low flow pipe and valve chamber and apparent lateral movement

The orientation of the pipe and chamber in relation to the embankment needs to be monitored for further

movement and could be checked between the 2018 survey and the recent survey to ascertain if there has been lateral movement.

The irrigation supply pipe is located higher up the embankment on the left side, as it was designed to supply water to the canal to the fields on the left bank of the river. As with the low flow pipe, there are no means of controlling the inflow of water to the pipe at the intake chamber, and should there be problems with the valve at the outlet, there will be a case of unrestricted flow until the water has reached the level of the intake chamber.

While this valve is operational, the pipe has been used as a further emergency mechanism to lower the water level in the dam and this full unrestricted flow has completely washed away the valve chamber at its end and its connection to the channel to feed the water to the irrigation canal. The end of the pipe and the valve are currently suspended in midair (refer to figure below).

Irrigation outlet pipe and non-existent valve chamber

5.2 Overall Legacy Issues at the Dam

Structural and non-structural risks are shown in the tables below.

5.2.1 Structural risks

Spillway risks:

- Erosion and structural failure
- Spillway design capacity
- Likely flooding, overtopping and crossing safety issues
- structure washaway risks
- Spillway return drop weirs and erosion,
- secondary spillway gullying,

Return channel drop structures and training wall risks:

- The return channel erosion and gullying

Embankment and slope stability risks:

- Livestock structural damage,
- Seepage
- Small crest width and
- Small freeboard leading to , overtopping risks

Rock toe risks:

- Obvious seepage from the dam,
- Silted rock toe
- Seepage and embankment instability – downstream community safety

Outlets and irrigation infrastructure:

- Unusable pipes- nonfunctional system- food insecurity

5.2.2 Environmental, Health and Safety risks

Construction phase

Demobilization and Restoration Plan absence risks:

- Unrehabilitated contractor sites
- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of community roads risks:

- Loss of and inadequate community access
- Loss of biodiversity

Rehabilitation of borrow pits risks:

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

Community health and safety risks:

- Access point drowning risks
- Drinking water from the dam, untreated may cause water borne diseases
- General serious or fatal incidents/drowning

Access across the river risks;

- Lack of an adequate crossing with increased risk of community injury and drowning

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
- Drinking water from the dam, untreated may cause water borne diseases
- Lack of an adequate crossing with increased risk of community injury and drowning

5.2.3 Social risks

Community development risks:

- Food security – lack of fishing and irrigation training for communities
- Dam construction not completed and no full usage of the dam
- Lack of water supply infrastructure for irrigation
- Lack of capacity/training to benefit fully from irrigation water supply

The following pictures illustrate some of the conditions above:

Figure 18 Disturbed, eroded areas and former borrow sites downstream of the dam

Figure 19 Downstream of the embankment showing soil loss

Figure 20 Upstream of the embankment showing an open area

Figure 21 Narrow crest access road, also showing signs of erosion

Figure 22 Spillway and causeway erosion; along drop structures- eroded areas and failed drop weirs 1

Figure 23 Spillway and causeway erosion; along drop structures- eroded areas and failed drop weirs 2

Figure 24 Former bridge access site; bridge buried in the loose sand after dam construction

Figure 25 Prior initial works campsite with existing non decommissioned house

Figure 26 Campsite with single housing next to the Spillway

Figure 27 Pedestrian and vehicular access road at the causeway

Figure 28 Embankment and causeway access road, June 2020

Figure 29 Flooded causeway access point, March 2021

Figure 30 Former unrehabilitated borrow area around the dam

Figure 31 : Unrehabilitated upstream borrow pit

Figure 32 Upstream borrow area, former anthill next to the main road that comes from spillway

Figure 33 Unrehabilitated borrow area, former anthill in a maize field

Figure 34 Borrow area, former anthill in a farm next to the dam

Figure 35 Existing borrow area south west of the former campsite

Figure 36 Existing borrow area at the former campsite with soil heaps

Figure 37 Borrow pit behind the Campsite housing, also used for animal watering when water logged

Figure 38 Unrehabilitated borrow pit next to the spillway and north of the campsite

Figure 39 Borrow pit next to the spillway and north of the campsite- with heaps of overburden material

Figure 40 Former arable land- downstream exposed rocks causing ponds and possible intrusive species environments, algae and poor water quality 1

Figure 41 Former arable land- downstream exposed rocks causing ponds and possible intrusive species environments, algae and poor water quality 2

Figure 42 Former borrow area; extensively open and eroded downstream area with sandy soils and rocks 1

Figure 43 Former borrow area; extensively open and eroded downstream area with sandy soils and rocks 2

Figure 44 Former borrow area; extensively open and eroded downstream area with sandy soils and rocks 3

Figure 45 Causeway undercutting, access safety risk

Figure 46 Drop structure complete washout and undercutting, dam safety risk

5.3 Potential Communities Affected by Works

The rehabilitation of the dam will benefit the dam community. The communities engaged during consultations expressed their desire to engage in increased irrigation activities that will lead to livelihood improvement. The works will therefore have significant socio-economic benefits as it will increase water in the dam that may be used for irrigation. This can include irrigation water supply for downstream communities.

Furthermore, the rehabilitation activities will create temporary local employment 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 50 people. Fifteen of these are likely to be externally recruited, including an engineer, a foreman, specialized construction workers, a storekeeper, and the ones to handle heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the communities. Approximately 35 workers will be recruited from the local communities. 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 in size 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, risk of exacerbation of local existing conflicts is low. Also, the potential that a workforce interferes with local communities from different political or factional backgrounds is small.

For the 15 external workers, the contractor will need to have a site office, for meetings and for the storage of materials. However, out of the 15 people, only the foremen, site men and storekeepers, and those handling heavy machinery and equipment are likely to be at the site for the entire course of construction. Hence, between 7-8 external workers will be at the site permanently. Workers will be transported to the construction site and likely remain there for the construction period. Staff like the engineer will visit the project site but will not be there the entire time.

The contractor will have to build a campsite for the 12-15 workers, who are not transported to the site on a daily basis and who are not locally recruited, as well as for storage or materials; and will have to provide convenience facilities for the whole workforce. The community respondents and local authorities, during field visits, indicated that the former campsite is still in place and can be re-used.

5.4 Dam Safety

The dam safety reports for Ngolongozya 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 as follows:

- 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 dam committee 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
- Dam committee 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 Embankment Remedial Design

6.1.1 Slope Stability

Slope stability analysis for the downstream embankment slope would require considerably more tests than are warranted for this size of dam. However, when looked at in terms of the ICOLD Manual on Small Dam Design, no stability issues are anticipated, particularly as this dam stores approximately 6m of water above riverbed level at the Full Supply Level.[27] If stability issues arise when the downstream raise is carried out, they will be addressed by the inclusion of adequate filters, a more substantial rock toe and placing of suitable shoulder material.

It is proposed to have a downstream raise of the embankment by 1.2m vertically with a 5m crest and maintaining the downstream slope of 1:2.5. There is no indication of a phreatic surface daylighting on the downstream slope of the current embankment, but given the uncertainty as to quality control of the placing, a 500mm wide chimney drain for the entire length of the embankment will be incorporated. This chimney will start at the current toe line and follow up the existing downstream slope (once it has been properly trimmed) effectively along the interface of the new placement against the existing embankment. This will extend to half the depth of FSL at the deepest section of the embankment and up to FSl towards either end of the embankment (see figure 47). This embankment rehabilitation will cater for the vehicular and pedestrian crossing by adjusting the crest width.

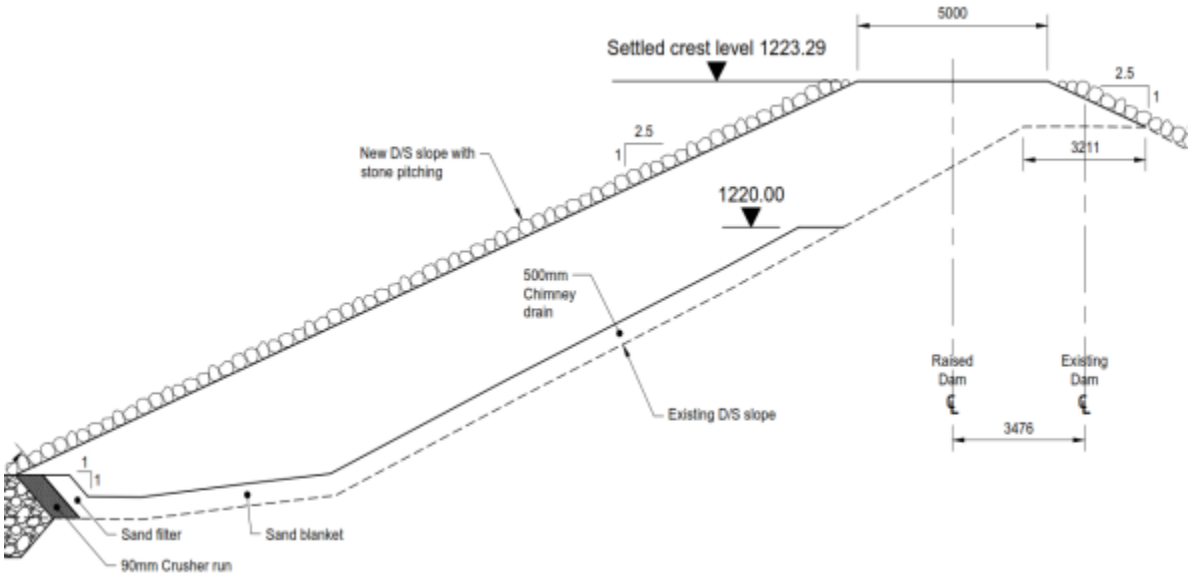


Figure 47 Raising cross -section showing location of chimney filter

Above the rock toe level, 1.5m x 0.5m finger drain offtakes at 20m centres on either side will lead off the base of the chimney to reverse filters into a toe drain constructed at the new toe. The raising will have the effect of moving the centre line of the current embankment downstream. It is proposed to remove the top 1.5m - the emergency raising section - and use this in the expanded embankment. The upstream

[27] Apart from the SPT and grading results, the team is awaiting some triaxial results, which will provide limited information as to the c and Ø value of the sample.

slope will have the riprap removed and the slope repaired and reprofiled where “beaching” has taken place. The riprap will then be replaced from the water line all the way to the HFL, with stone pitching the rest of the way up the slope to the new crest. This will prevent any future livestock damage to the embankment.

6.1.2 Seepage Downstream

This covers the areas observed beyond the raised toe of the dam where seepage has been observed:

At the downstream toe of the embankment: excavation of channels to direct the seepage flow away from the embankment and allow some drying of the area. This will be incorporated in the proposed key trench to be excavated in this zone. This will involve clearing of all the unsuitable material in these areas to a competent foundation for filter placement. The drain has to be deep enough to allow for seepage passing beneath the embankment to enter drain and not daylight - this will assist in reducing the pore-water pressure beneath the embankment near the toe and improve the stability. The exit points of the subsurface drains will be channeled to be measured through a fixed V notch for ongoing monitoring.

Downstream of the embankment on the right bank: straighten and extend the depth of the erosion gulley from the secondary spillway to further draw down the seepage water beneath the embankment from surfacing. Take to depth of 3m and place a subsurface drain with filter medium and slotted pipe at the base. Backfill with suitable material back to natural ground level. This will assist in further reducing the pore-water pressure beneath the embankment, and reduce seepage outflow at the toe. Overall it will assist greatly with stability and drying out the toe and prevent cattle from congregating in the wet spots.

6.1.3 Rock Toe

The original downstream rock toe constructed has been covered with siltation from the spillway breakthrough return channel erosion. This will need to be cleared to expose the existing rock toe and allow the free drainage of the pool at the low point. A more extensive rock toe will need to be placed in this area, extending at least two meters vertically up the embankment face and will incorporate a reverse filter on its upstream side to cater for any seepage passing through the embankment at this point. In addition to controlling riverbed section seepages the rock toe will provide additional weight against the embankment at its deepest section, thereby increasing its overall stability (see figure 48).

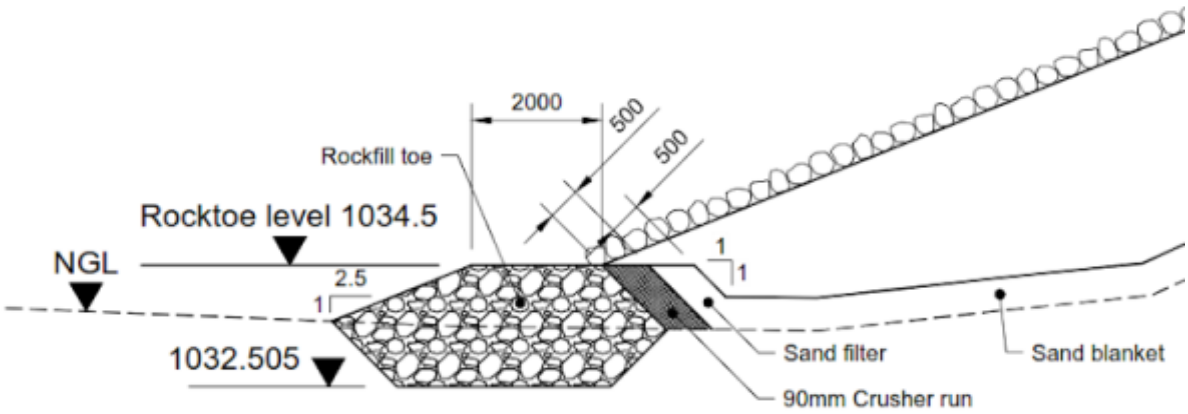


Figure 48 Typical section of rock toe and filter in the riverbed section

6.1.4 Concrete Stone Pitched Open Toe Drain

This will be constructed at the new downstream toe to collect outflow from the internal filters as well as runoff from the embankment slope. This should be an open concrete lined or stone pitched drain that can be regularly cleaned out if necessary as the open earth drains that are filled with stone invariably soon clog up with silt and become ineffective. The upstream slope of the drain should match that of the downstream embankment slope - i.e., 2.5:1 - and the downstream slope can be cut at 1:1(see figure 49). The surface toe drains on either side will end at the start of the rock toe and be diverted along the edges of the rock toe to discharge into the river bed. Both of these discharge drains will be fitted with fixed V notches to enable the measurement of the flow in the drains.

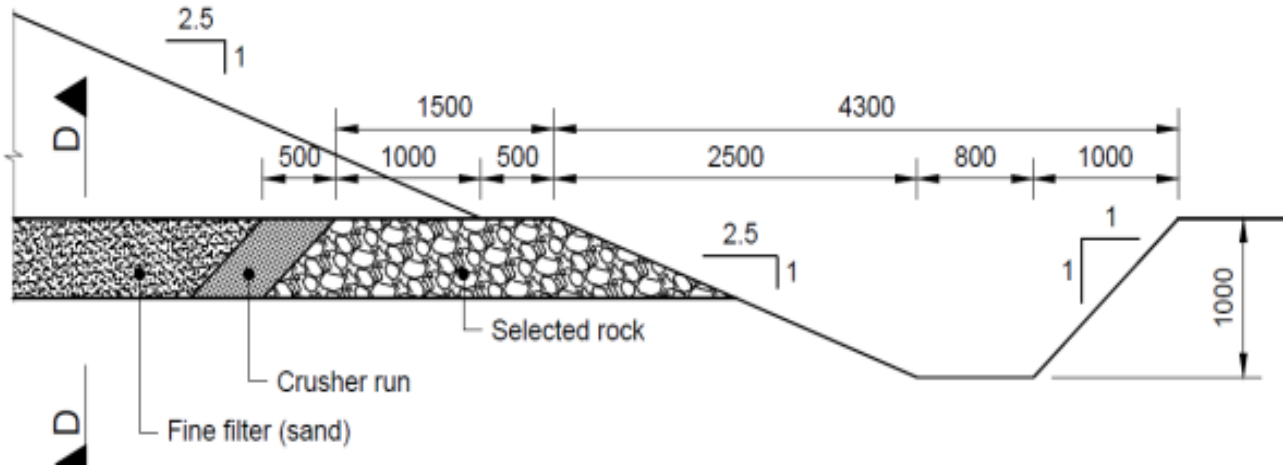


Figure 49 ypical section of toe drain and embankment internal filter

A good alternative is the use of a suitable concrete filled membrane roll - such as “Concrete Canvas” - which can be rolled out along the earth channel profile and simply watered to activate the concrete mixture. Due to the unavailability of suitable construction materials in the immediate vicinity of the dam, the cost of this alternative should be compared with the cost of bringing in suitable stone for a stone pitched channel or the concrete for a concrete lined channel.

6.1.5 Reverse Filters Beneath the Current Toe

These will be installed as far back in as can conceivably be cut to link with the original blanket filter if found. They will be specifically in the current areas of seepage exiting the embankment and do not necessarily have to extend the whole length. The filter should consist of a 250mm layer of sand overlain by a 250mm layer of 9mm aggregate overlain by a 250mm layer of 19mm aggregate.

6.1.6 Slope Protection

To protect both upstream and downstream slopes from livestock damage it is proposed that stone pitching both faces will preserve the slopes more successfully than any fencing, as this is a communal area.

6.2 Service Spillway, Drop Structures and Training Wall

6.2.1 Spillway

As previously stated, the spillway is currently a 4m wide and 53m long concrete drift extending off the left hand end of the embankment with a common centerline with the embankment. The raising of the embankment by 1,2m and widening of the crest width back to 5m will shift the centerline downstream approximately 8m from the current embankment centerline. The new spillway/drift will have a similar downstream shift so its centerline to coincide with the new centerline of the raised embankment. The spillway rehabilitation will cater for the vehicular and pedestrian crossing.

It is proposed to install two lines of gabion baskets at current spillway level with a 250 mm 6m wide concrete capped road way between them. The gabion baskets forming the downstream edge of the causeway will have a 2m Reno Mattress extending downstream and between them will prevent any undercutting by the water flowing off the causeway. There is a limited drop of 250mm from this structure to the first 1m drop structure. The road approaches off the dam crest and on the left bank of the spillway / drift will be a grade of 1:8. This will require a double head wall on the dam embankment and similar protection to the left bank. These abutments will also be constructed of gabion baskets, which will be keyed in 2m at either end of the spillway. The abutment walls and cut off walls will extend up to at least the height of the High Flood Level - effectively the wet freeboard

The upstream approaches to the abutments and downstream outflow sections away from them will be protected by a 2m gabion mattress. In an effort to improve the flow characteristics it is intended to deepen the approach channel to the spillway section by 500mm and attempt to rock break out the upstream high point in the channel.

6.2.2 Return Channel Drop Structures

The first drop structure after the spillway drift will be set 2500mm below FSL and, as previously stated, the return channel will be controlled with gabion drop structure bolster lines (see figure 50) - at 1m vertical intervals, back down to the riverbed level. Each 1m drop on the downstream side of the gabion structure is protected with a 2m wide Reno Mattress as well as on the upstream side, to reduce the willow undercut of the structure. The crest of the next drop structure is at the same level as the upstream drop. The channel will be stepped and levelled across its width between each drop and the suitable material will be used for the embankment raising or the training wall remedial works. The critical point of each such structure will be its connection with the training wall; this is where the gullying may occur. A 2m gabion mattress will run up the entire embankment both upstream and downstream of the head walls and will be tied into the head wall and link into the mattresses.

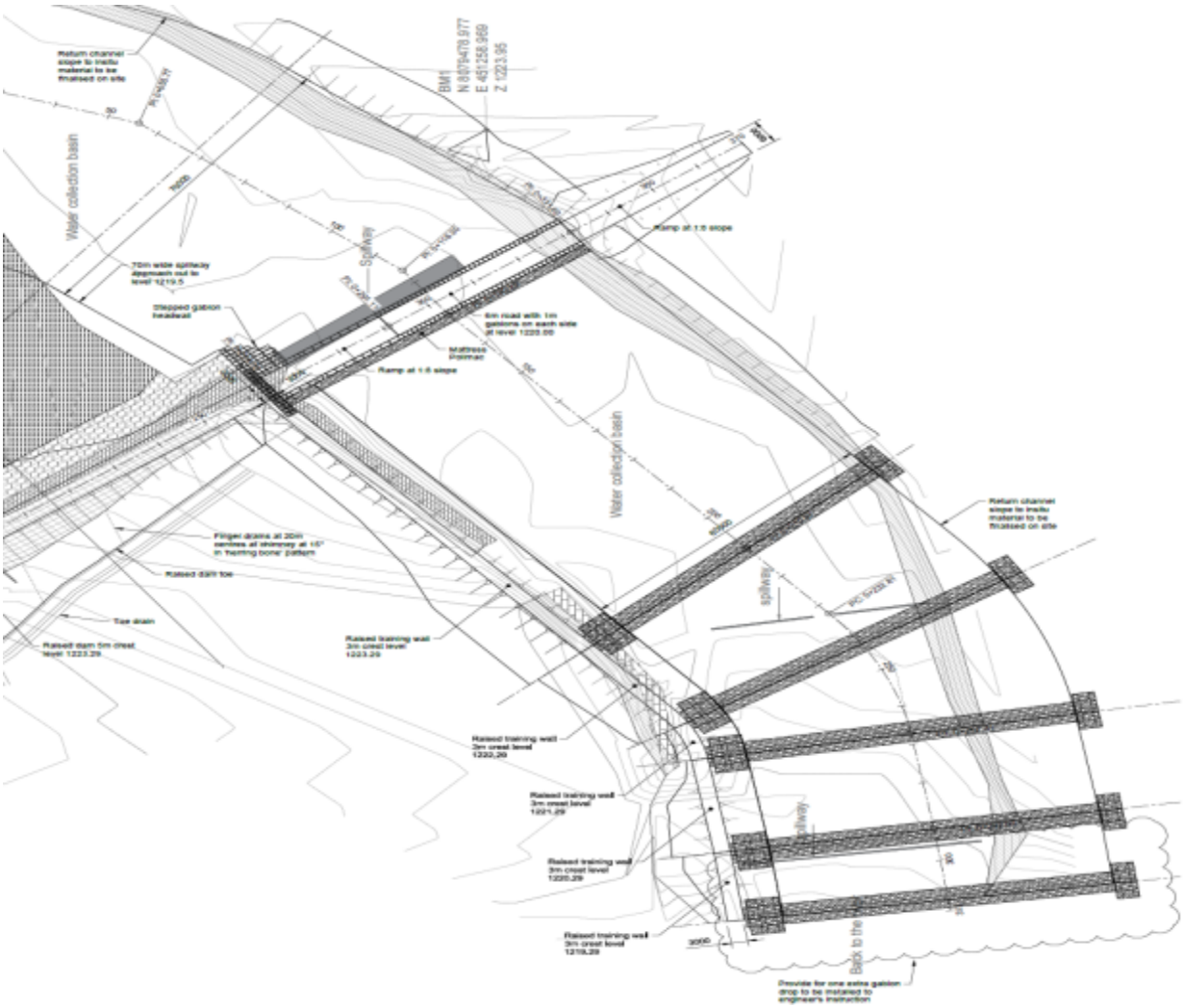


Figure 50 Plan View - Layout of new gabion bolster drop structures.

6.2.3 Return Channel Training Wall

The existing spillway return channel training wall will be replaced with 3.0m crested earthfill embankment with 1:2.0 slopes. After each drop structure headwall, the crest level will reduce by 1m in keeping with the drops. In some places the return channel will need to be widened to the full width of the spillway. The widening will be from the left bank natural ground and cut to the same slope as the training wall embankment (1:2.0); and will be stepped in a similar way as to the training wall with a bench up to natural ground level from the reduced crest level at each section. This material will be used in the embankment raising or in the training wall construction. Any gullies remaining after each step down and low spots will be backfilled in with rock and levelled to provide an even surface for the water to flow over.

6.3 Outlets

There are two 300mm steel pipe outlets located on the right and left banks of the main wall. The left bank outlet was to serve an irrigation block but this seems to have been abandoned as the return

channel and subsequent breaching of the training wall have made the irrigation block inaccessible.

It is however used as an emergency discharge during periods of high flood and this has washed away the valve chamber structure and created a large wash area that will need to be repaired. The right bank outlet is blocked. It is proposed on both that these pipes will be carefully exposed and a wide reinforced concrete base be cast on a suitable foundation and thereafter a reinforced concrete surround will be placed around each pipe. It will be reverse filtered on the entire exposed length. The pipes will not be extended. The left bank pipe will require a wing wall protection.

6.4 Construction Materials and Amenities

Construction materials required for the remedial works as detailed above are as follows:

- Sand and stone for minor concrete works - from Kalomo River - 20 km.
- Stone for gabion basket filling - quarry near Zimba - 20km.
- Rock for riprap and downstream toe - quarry near Zimba - 20km.
- Common fill for embankment raising and spillway training wall.
- Wearing coarse gravel for roadway on crest - local ZNS gravel pits.

The contractor and the engineer will work together to determine the exact locations of these materials. To protect the environment, material will not be sourced within the immediate vicinity of the dam as was done in the initial construction works. The environmental and social mitigation measures detailed in the ESMP table will apply during sourcing, extraction and decommissioning. Permits for sourcing will be obtained prior to material extraction. The permits required include land acquisition agreements and ZEMA permits/ management plan.

Guidance on identification of sites will be as follows:

Sources of materials for construction 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 Dam Committee and the local community with a view to get consent from the local leadership and avoid land and other conflicts. Should the sources selected prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas, and still execute the same channel of consultations to get clearance from the local leadership and the municipal council. 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.

Rockfill and Aggregate***:*** The rock requirements for the dam are 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. All suitable rock obtained from excavations for the dam and appurtenant works will be used in the structures, and every effort must be made to save as much rock as possible for this purpose.

Concrete aggregates will be obtained from the Zambia Environmental Management Agency (ZEMA) approved quarry sites or from an approved commercial supplier identified within Zimba District or

nearby, provided they are economical. In some cases the contractor will set up his own crushing and screening plant. However, the latter process may take longer to be approved by ZEMA, since this will require preparation of an Environmental Project Brief 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 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. No materials will be taken for any purpose from within 200 meters upstream or downstream of the dam centerline, nor within 50 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 is expected to have an understanding of suitable deposit sites prior to tendering.

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 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, gravel over a long distance and passing through a settlement of some community, 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:

Water Supply: The contractor will provide temporary potable water storage facilities and connection to the existing local borehole that is within 3km of the dam without compromising community access to the water. Water from this well was tested (refer to water quality section 4.1.4). It is safe for drinking and can be used by the contractor and its staff. The hand pump borehole location is at the local Primary

School within 500m of the dam.

Campsite: A campsite for 12-15 external workers will be structurally constructed within the site off the access road, on the left side of the dam. This will be beyond the former campsite and will be within the Zambezi Tonga area, as advised by the communities. The contractor will provide the following for the site:

- Washing and sanitation facilities- incl. VIP latrines to be constructed within the site for ca. 50 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.
- Cooking facility at the campsite- all the cooking activities will only be conducted at the designed facility. Waste management (non-hazardous waste) - collection from waste receptors within the site, and disposal at council designated site located in Zimba urban at Lat. -17.315255; Long. 26.169938.
- 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 bunded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- Temporary accommodation facilities for staff. The temporary facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- 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.

Additionally, the contractor will ensure to the extent possible that the camps are constructed from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop-down toilets, generators 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 and the contractor will make his own arrangements for a suitable site for his camp, after engaging the relevant persons for that piece of land. The contractor is expected to indicate where they intend to set up their site camps. The contractor will ensure that the identification and subsequent operation of the camps meet local and international environmental and social safeguards.

Access Roads: Access to Ngolongozya Dam is through a 36 km road from Zimba, made from gravel, off T1 road. The access road is shown on the Land use map.

Labor Force: The total workforce will be approximately 50 people. 15 out of this amount are likely to be externally recruited, including an engineer, a foreman, specialized construction workers, a storekeeper, and the heavy machinery and equipment operators as it is not expected that specialized or skilled workers will be available in the Zimba communities. Approximately 35 workers will be recruited from the Zimba communities.

6.5 Construction Programme

Considering the Scope of Works and possible sources of materials as listed under materials, the rehabilitation works will be completed within 6 months.

6.6 Drawings List Available to the Contractor

No.	Description	Drawing No.
	Raised Embankment Layout	ZM/DAMS/NG/C01
	Embankment Cross Sections	ZM/DAMS/NG/C02
	Spillway Layout	ZM/DAMS/NG/C03
	Spillway Details	ZM/DAMS/NG/C04

7. Risk and Impact Mitigation Plan

This section provides the following: common construction works management plans, monitoring requirements and the rehabilitation management plan after the current proposed works. The contractor is expected to operationalize these plans with details of his/her method statement.

7.1 New Remedial Works General Construction Works Management Plan

Table 9 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 1000/month
Hazardous Waste Management						
Construction activities **Vehicular**	Hazardous waste generation and releases into	• 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 1000/month

operation **Sanitary facilities**	the 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 site, 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 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		● 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	

		contaminating the surface water with oil leakages from the vehicles.				
Soil Management						
Excavation activities during material source extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilizatio n leading to erosion and land subsidence Road surface instabilities	● The contractor will prepare detailed disturbed areas and 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 avoid collecting soils from around the site, further causing soil destabilization. ● The contractor will ensure that site installation, excavations and any other soil movement activity will not be done during the rainy season to avoid erosion of material and gully formation. ● The contractor will methodologically conduct site assessments, selection, and operation of the sites as indicated: A depth of utmost 2.5m will be excavated from borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope, and indicated in the method statements. ● 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 only used for reclamation purposes when pit operation is complete.	Construction Phase Daily	● Minimized land and soil disturbances at the work sites ● Suppresse d dust levels and soil movement / erosion ● All sites are soil stabilized sites ● Separate soil stockpiles to specification ● Drainage and runoff control ● Site restoration, 90% for regeneration ● Site Method Statements and management plans prepared	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Dam Committee	HSSE Officer Cost 2000/month

		• 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 restore sites after works. This will include rehabilitating disturbed work areas and restoring as close as possible to original contours. Replant vegetation with native plant seed mixes. Overburden soil can be used for landscaping and drainage.				
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. • The contractor will avoid land disturbance and avoid further site disturbances around the dam downstream and return channel sites.	Construction Phase Monthly	• Minimised aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost 1000/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 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 Phase Monthly Or as required in case of an emergency/ incident	• Refer to water quality results in the ESMP • Water quality results, monthly • The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

		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.		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) additionally with total and fecal coliform tests. If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods. ● Pollution control structures ● Training records, 100% of workers trained ● Inspection s 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 sensitized 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 1000/month
Construction materials (sand, stone, rock, gravel)						
Extraction and transportation activities	Land degradation, falls, waterborne diseases due to collecting water, health and safety injuries during mining, non ZEMA regulated activities, soil erosion, biodiversity loss, traffic accidents, noise	• The contractor will source materials from reliable, regulated sources with ZEMA approved operations or will conduct the mining themselves using the approved environmental and social mitigation measures shown in the soils and land management plans. • The contractor will refer to the relevant management plans in the table; traffic, labour, air, noise, water, soil, land, health and safety. • The contractor will also refer to the relevant management plans discussed under Appendix J • The contractor will not source	Construction phase Daily	• Refer to the remedial design report • Use of approved and regulated mining process • Refer to the relevant plans' performance indicators • Legal permits for material sources to avoid conflicts with land owners and users	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

	and air quality, child labour from unregulated sources	material within 500m radius of the dam due to existing excavations, material sourcing and land degradation caused by prior construction works. Local land use permits and ZEMA permits will be obtained prior to material extraction. These areas will be rehabilitated for future use by communities. ● The contractor will not practice blasting. ● The contractor will ensure that sand mining does not affect biodiversity and flows- a method statement should be developed for the sites.				
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, surface and ground water pollution, soil conservation, land pollution/	● 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. ● 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.	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

	degradation, health and safety risks					
Traffic Management						
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• 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 affirm procedures and include cost. The plan will include the need to cover the raw material with a tarpaulin to ensure there is no pollution caused to the local community. Additionally, once the source of raw materials are known, the contractor, working in consultation with the Engineer and the local authority will define a route to use during the transportation of the raw material • Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitizations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h).	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records • Traffic Management Plan in place	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Dam committee	HSSE Officer Cost 500/month

		• 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, and instructions or procedures for controlling traffic including in an emergency will also be included by the contractor.				
Biodiversity Management						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	• The contractor will implement the BMP • The contractor will minimize impacts on notable species and loss, fragmentation, alteration, disturbance and disruption of sensitive habitats, as guided in the BMP. • The contractor will avoid introduction of alien species that may affect other resident species in the waters. • The contractor and communities will avoid exploiting biological use of resources and invasive methods by following regulations and training. • The contractor will make	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 1000/month UNOPS ecologist consultant costs

		reference to the BMP annexed to this document and prepare an aquatic biodiversity site/ habitat specific method statement for works which the contractor will communicate to the contractor workforce. This 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 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, 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, a separate report annexed as appendix J , the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered species, and protect nests. ● The contractor will report all incidents to UNOPS and to authorities.				

Terrestrial Biodiversity Works within habitats	Biodiversity and habitat loss	● The contractor will adhere to the Mitigation measures as guided in the BMP annexed as a separate report to this ESMP ● As guided in the BMP, 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 ● The contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organize alternative energy sources. ● The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimize destruction of terrestrial biodiversity. ● Contractor to prepare an aquatic biodiversity site/ habitat specific method statement which 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 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	Construction Phase Daily	● Rehabilitation records and extents ● Extents and number of disturbed sites and species ● Maintain a fauna sighting and fatality register. Conduct regular monitoring of works to ensure compliance ● Training records and fauna register	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost UNOPS ecologist consultant costs

		the method statement applies. ● The contractor will report all incidents to authorities and UNOPS				
Community Health and Safety						
Lack of safety measures	Community Health Risks, which include accidents, injury and drowning in open sites such as a 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 community living close to the dam and especially those living upstream of the dam will be informed of the importance of having their own convenience to avoid open defecation. This practice can otherwise impact on the surface water quality and consequently may cause water borne diseases among the local community accessing this water. ● The contractor will adhere to COVID-19 regulations and SI instruments to protect the workforce. The Contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F). Adequate hygiene points will be set up around the	Construction Phase	● Adequacy of safety signage ● Training records ● Refer to the technical safety reports ● Water quality free of coliforms and essentially within the WHO limits.	Contractor Engineer and HSSE Officer UNOPS/ IDSP Ministry of Health	HSSE Officer Cost 2000

		site, temperature will be measured daily for each worker, suspected cases will be reported to the local clinic etc… ● 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 such as the DMC 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.				
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 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,	Construction phase	● Training of workers, record in place ● All wokers in rightful PPE ● Good housekeeping	Contractor Engineer and HSSE Officer	HSE Officer Costs

		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. ● 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 aim 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.	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	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

		• UNOPS to train senior GRM staff in GBV/SEA appropriate responses and referral mechanisms. Training of the 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		to use as a minimum • 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations • Community awareness sessions 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		
GBV/SEA	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 the survivor has agreed based on informed consent.	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

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 information on CoC (in local languages) • Contractor to conducts cultural sensitization of workers.	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
Conflicts	Conflicts between workers, based on cultural or other differences	• The contractor will design and implement a workers' GRM.	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget

	Risks of disagreements between local workers and employers	• The Contractor will operate workers' GRM.				
Labour Influx	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
Occupational Health and Safety	Occupational Health and Safety Risks	• Occupational health and safety requirements will include hazard identification-elimination, substitution, controls, communicate risks, training, emergency preparedness and response, adequate and relevant personal protective equipment, incident investigations, monitoring. • COVID-19 spread at the construction site to be mitigated through the attached plan (see appendix D).	Construction Phase	• Emergency preparedness and response plan for occupational emergency situations • Report on COVID-19 mitigation plan implementation	Contractor UNOPS	HSSE Officer costs
Decommissioning and Rehabilitation Measures (Structured management to minimise environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the contractor's services and equipment used in performing the work**	Residue impacts Aesthetic impacts Safety hazards	• The contractor will review the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations. • The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology,	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs 40,000

required under the contract		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. 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	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		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 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 replanting of native plant seed mixes suited to the area	Construction Phase After conclusion of works	● Rehabilita ted and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		at three trees per one removed tree. Local/ native species are indicated in this ESMP. ● The contractor will create an ideal and safe crossing downstream of the dam. Crossing over the embankment may not be safe for the community. ● 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 /dam committee (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 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	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

		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 contamination plume and bio-remediated in a land farm. Where the contamination plume is willow, 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 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 damp 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 required to stockpile all the felled trees. There will be no burning of burying any felled trees.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
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
Environmental Flow	Ecological flows	● The contractor will install the user friendly durable flow gauge for regular flow measurements during the runoff season. ● Ensuring balancing of flows and ecosystem needs, as suggested in the BMP. ● UNOPS will conduct training for the Dam Committee on flow reading. ●	Construction Phase	● Training and flow monitoring	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 sanitisers and face masks.	Contractor Engineer and HSSE Officer	**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 Ngolongozya 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	Dam Committee/ Water User Committee Ministry of Agriculture DWRD	
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. • Refer to IDSP Pest Management Plan.	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) are applied • Training/ sensitization records, 100% • Water quality monitoring records	Dam Committee/ Water User Committee Ministry of Agriculture DWRD 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 sensitisation 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	Operation Phase Quarterly	• Water quality results • Pollution control structures • Training records	Dam Committee Ministry of Agriculture Forestry IDSP	300/month

		management practices, stock watering control and soil conservation. • Refer to IDSP Pest Management Plan.				
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	Dam committees Ministry of Health	
	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 at least 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	
Traffic Management						
Maintenance of access infrastructure	Deterioration of access infrastructure Safety hazards	• IDSP will sensitise the community on appropriate use of the infrastructure to avoid	Operation Phase Quarterly	• Training records • Inspection records • Maintenance	Dam committee IDSP	500/year

		and minimise failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. ● IDSP will train the dam committee on use, maintenance and monitoring requirements of the embankment and causeway crossing.		records		
Basic Biodiversity Management and Flow Management						
Aquatic biodiversity 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 where feasible ● 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.	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 ● Training records	Dam Committee Fisheries Forestry UNOPS IDSP	1000/year

		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. Dam committee to strictly monitor inflows, retention water and outflows in order to have a balanced system. ● UNOPS to include outlet infrastructure for downstream flows ● Dam committee to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. ● Dam committee to monitor flow level changes downstream. Natural flows and dam controlled flows. ● Communities to protect vulnerable and endangered species.				

		• Avoid exploiting biological use of resources and invasive methods. • Ministry of Agriculture working with department of fisheries to train the community and dam committee that benefit from the ecological value of the dam so they can learn sustainable fishing skills and preserve the fish juveniles in the willow waters • Secondary developments to take aquatic biodiversity into consideration				
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• The BMP will be implemented. • Active control of invasive and alien species after trainings by government departments.	Operation Phase	• Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	1000/year
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	• IDSP to train dam committee in E&S issues indicated in the UNOPS and contractor training plans.	Operation Phase	• Dam committee exists • Dam committee has been trained	IDSP local authorities	1000

Catchment Management						
Catchment management	Increased erosion and sedimentation	• The IDSP will ensure the dam committee and officers from the departments of forestry, water resources and agriculture are oriented to appreciate the contents of the 0&M manual, use and benefits for sustainable management of the dam catchment area	Operation Phase	• Training of the following in the implementation of O&M: • Dam committees • Water resources development • Agriculture • Campsite officer • Forestry	IDSP DWRD Dam committee	In training costs
Community Health and Safety						
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	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records • Refer to the technical safety reports	Dam Committee Ministry of Agriculture DWRD IDSP	500/year

		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.				
Gender Equality and GBV Action						
Gender Mainstreaming	Dam Committees do not have female members	● UNOPS will define gender parity in constitution of the dam committee and include gender equality training in the training of dam committees.	Operation Phase	● Dam Committees 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 dam committee trainings on dam maintenance and dam safety. ● The dam committee will ensure incidents are reported to the resident IDSP staff and responded to. ● UNOPS and IDSP will conduct maintenance and flow inspections trainings for communities and district officers. ● Community	Operation Phase Bi annual	● Dam committee Quarterly meetings and resolutions ● Flow measurements and action plans ● Training records ● Catchment management activities ● Dam maintenance records and monitoring records ● Refer to the technical safety reports	UNOPS IDSP DWRD Dam Committee	2000/ year

		will implement catchment management measures in the BMP ● 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				
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 BMP.	Monthly	● Refer to the biodiversity assessment and BMP ● Monitoring records ● Pictures ● Training records ● Flow measurements ● Water quality results, monthly The monitoring parameters will include biological, physical and chemical drinking water quality 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	UNOPS IDSP DWRD Dam Committee	4000/ year

				(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) additionally with total and fecal coliform tests. • If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods.		

7.2 Rehabilitation and Remediation Plan for the Previous Works' Sites

This section discusses aspects requiring rehabilitation before the contractor demobilizes from the project area. The remediation plan is to a larger extent covered in the actual design works for remedial works, and hence limiting the discussion in this section to those 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 and that 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 100% 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 on the next page identifies aspects requiring rehabilitation by the contractor to ensure compliance with environmental safeguards which include demobilization of the contractor and the restoration of the Ngolongozya dam site. The rehabilitation works are elaborated in the table below.

Table 10 Rehabilitation and Remediation Plan for Previous Works Sites

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Structural risks			
Embankment	Location: Embankment slopes, width, pedestrian/ vehicular access route, possible overtopping, livestock damage Images: Section 5 'Dam Characteristics' Risks: structure failure, soil loss, overtopping, community safety, seepage	Refer to the dam design reports. Restrict cattle access to the D/S embankment by stone pitching it Remove the riprap on the upstream slope and repair and reprofile where "beaching" has taken place To protect both upstream and downstream slopes from livestock damage by stone pitching both faces Raise downstream embankment by 1.2m vertically with a 5m crest and maintain the downstream slope of 1:2.5 Remove the top 1.5m - the emergency raising section - and use this in the expanded embankment Excavate channels to direct the seepage flow away from the embankment and allow some drying of the area Clear all the unsuitable material in these areas to a competent foundation for filter placement Create drain to be deep enough to allow for seepage passing beneath the embankment to	*Timing:* Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: construction contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand- quantities 260m^3., Rock quantities 500m^3., Crusher runner from a commercial quarry , quantities 260m^3 The equipment required includes: backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to 10 machine operators and 15 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Stabilized slopes Secure access points for the community Adequate freeboard Gullying and erosion protection	In BoQ

		enter drain to improve the stability				
Spillway and drop structures	The structures have been washed away and show significant erosion Images: Section 5 'Dam characteristics' Risks: structure failure, soil loss, erosion	Refer to the dam design reports. Construct new causeway with a correctly sized cut off at the front of the foundation to prevent undercutting and a sill section separate to the main causeway, but as part of its upstream edge. This sill will obviate the need for edge markers on the upstream side of the causeway. Similarly, where the flow over the sill exits the causeway, construct another vertical cut off to prevent undercutting Ensure road approaches will have gabions and proper slope Replace the existing spillway return channel training with crested earthfill embankment. Backfill with rock and level any gullies remaining after each step down and low spots	*Timing:* Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation role: construction contractor Supervisor: UNOPS *Materials and equipment* Rock, quantities 150m^3 Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* up to 3 machine operators and 25 laborers as per above and up to 4 months	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated spillway, causeway, and adequate gabion presence	In BoQ
Non-structural risks						
Waste and rubble snag list	The former campsite was located next to the spillway southwards; borrow area and road near the end of causeway (refer to Land use Map)	Relocate site away from the sensitive receptors such as the embankment access route Ensure systematic clean up and decommissioning of the structure Ensure revegetation, leveling, drainage construction, proper	*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 *Materials and equipment*	Decommissioned and rehabilitated site	Decommissioned and rehabilitated site	In provisional sum in the BoQ Day works

	Coordinates 17°22'14.48"S, 26°32'26.01"E There is currently one small house (about 5m x 3m) on the site as shown in figures in Section 5. It has significant vegetation clearance, given that a systematic clean up and rehabilitation was not done.	collection and disposal of rubble	Earthworks Equipment backactor; tractor dumpers; and haul truck *Workmanship and timeline:* up to 6 machine operators and 5 local workers for less than 4 months.			
Hazardous waste snag list	Not present on site					
Borrow pits	Location: There are several unrehabilitated borrow areas around the site both upstream and downstream. These contributed to terrestrial biodiversity loss. The upstream ones were anthills and the downstream ones were flat arable land just below the embankment toe	Conduct earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, and revegetation by seeding. Partially fill borrow areas with acceptable material to form a safe landform and grading to a desired landform slope and drainage. Stock the existing vegetated sites' soils during borrow pit use and place back the top soil when works are done. Plant native seeds where possible. Construct appropriate surface slopes with drainage channels to prevent water from collecting at the site. Final slopes within the site will be a maximum	*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 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	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Contouring Drainage Stabilized slopes Desired landform Maintained downstream soils	In provisional sum in the BoQ Day works

	and around the spillway. The extents are variable and extensive. When these flood in the rainy season, they are used as a watering point for animals. The borrow slopes are open with signs of erosion, uneven excavations and overburden soil heaps. Images: Refer to the map and images in Section 5 and the Land use Map. Risks: community health and safety, biodiversity loss, dam structural integrity loss	horizontal to vertical slope (H:V) of 3:1 or 33% grade. Ensure drainage to avoid accidents and public health risks. Stabilize the areas of disturbance and steep slopes. Reinstatement by 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.	patterns on the closed roads. *Materials and equipment* Earthworks Spoil Soils for top soiling Grass seeds- approved native species Watering equipment Fertilizers/ soil fertility promoters Equipment backactor; tractor dumpers; and haul truck Workmanship and timeline: up to 6 machine operators and 10 local workers for less than 4 months.			
Access routes	Location and condition of the sites: the access road (about 37 Km from the T1 Road, southwards) is in a moderately poor condition, eroded over the years with a poor surface. There are 2 routes	Structural remedial measures above in the design cover for the structural risks of the access road over the crest. Edge protection at the causeway to be included for safety measures. Road rehabilitation will be done by earth ripping to enable	*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 *Materials and equipment* Earthworks Limited gravel utilizing existing	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Assisted revegetation Remediated access route and raised, safe crossing points with gabion presence	In provisional sum Day works

from T2 (see land use map). The Contractor did not repair the road leading to the site after or during works. This is the main district. The road goes over the embankment and spillway causeway. The crest width only allows for one car at a time - the safety of the road. Moreover, the road does not have guardrails at the dam site.
Access is subdued by the spillway due to water logging and fast flowing water during the rainy season. The other impediment is that the entrance slope causeway is too steep for vulnerable populations and vehicles.(extents shown on the land use map)

Images: Section 5

Risks: community

regrowth of natural vegetation and assisted revegetation with native seed mixes. The unnecessary roads should be close by agreeing with the community and scarifying the roadway, ripping and recontouring

surface to form with a grader and tractor dumpers

Workmanship and timeline:
4 Operators and 8 laborers as per above equipment 4 days per equipment

	access impediment over the dam structure					
Eroded and disturbed areas	Open and erosion susceptible areas include the D/S of the embankment, the upstream left slopes, the spillway channel, the embankment toe area, dam downstream zone and the former borrow areas shown in the Land use Map. These opened up areas have led to sedimentation, loss of flow, loss of biodiversity and significant soil movements. Loose soils/ sand covering infrastructure downstream such as the old bridge Livestock watering contributes to soil loosening and siltation of the basin and embankment	As shown under borrow areas above Designate livestock watering points and soil stabilization to be promoted by stone pitching, and intensive revegetation using seed mixes, fertilizer and watering Contractor will prepare detailed method statements for all disturbed sites quantifying all sites and indicating the remediation methods	*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 *Materials and equipment* Earthworks Compacting, stone pitching material and seeding revegetation 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	Contractor 3 year liability period Site inspections Pictures Continuous maintenance	Soil stabilization around the site Leveling with drainage	In provisional sum Day works

	Risk: dam basin siltation, poor water quality contribution, limiting water use, soil movements and loosening					
Community health and Safety	Lack of safety signage around the dam Lack of safety and health sensitization in regards to the dam Risk: accidents and waterborne diseases due to lack of knowledge and signage warning	Design of signage and location mapping - approved standard dam safety signage around the dam and contractor sites for construction and operational phases Implement community sensitizations and training planned in the ESMP, including training on drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc.	*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* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 workers	Contractor liability period Site inspections Pictures Continuous maintenance Dam committee regulation	Training records in all stipulated topics Existing correct signage Signage method statement	In provisional sum Day works
Irrigation outlets Fish stocking	Location and condition of the sites: lack of working irrigation infrastructure Risk: livelihood impacts, dam not used for its full purpose	Include fish stocking by the Ministry. Dam committee to follow up with the Ministry after handover. Include outlet repairs in the design for operation Provide training in fisheries, livestock management and garden watering	*Timing:* day works - commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation role: dam committee, fisheries and agriculture departments Supervisor: UNOPS *Materials and equipment* Fish stocks with stock assessments	Contractor liability period Site inspections Pictures Continuous maintenance Dam committee Livestock, fishing and irrigation regulation and control	Existing dam uses Training	In provisional sum Day works

			Outlet infrastructure remediation *Workmanship and timeline:* 5 persons (indicate expertise and No.) irrigation equipment, 1 month days			
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 Implementation role: construction contractor, dam committee Supervisor: UNOPS *Workmanship and timeline:* 1 operator and 4 laborers concrete mixer and poker vibrator equipment type and days	Contractor liability period Site inspections Pictures Continuous maintenance and biodiversity monitoring	Installed monitoring gauges Training records	In provisional sum Day works

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 Ngolongozya 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 Table 11 has been proposed for capacity building of district government staff, dam committee members and community members (upstream and downstream). The implementation and execution of the sub-project will include additional training of relevant staff and communities, stationed in the various sites, in environmental and social due diligence during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health centre, district department representatives, UNOPS E&S Team, UNOPS Dam Safety Team, IDSP and the contractor.

In addition, the contractor will include in their work plans and carry out training of workers on the required safeguards 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.

Training monitoring 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 plan.

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 8[28]:

Table 11 Training plan

Training Content	Number of Days, Time, Frequency	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, Gender based violence, 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 Specialist	150 community members 15 District DMMU members Dam committee
Estimated Costs: 3,000 USD 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 ● Ministry of Chiefs and Traditional Affaires ● DWRD ● Ministry of Health

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

		IDSP: Dam safety Specialist Environmental and Social Specialist	• Forestry Department • Ministry of Gender • Community Development • Ministry of Fisheries and Livestock • Ministry of Agriculture
Estimated Costs: 1,500 USD			
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 costs: 1,000 USD per session			

9. Stakeholder Engagement

The Stakeholder Engagement Plan seeks to define a structured, purposeful and culturally appropriate approach to consultation and disclosure of information during the preparation of the ESMP and implementation stage. UNOPS and IDSP recognize 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 to ensure that feedback can be received in relation to the remedial works for the Ngolongozya Dam. It is set up to respond to concerns and grievances of the local communities 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.

Dam committee 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 in order 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 Ngolongozya dam communities are stated below:

Table 12 Concerns Raised by Communities

Department/ organization	Concerns/ input	Response
District Commissioner	● The rehabilitation works of the dam are necessary. ● This will allow for completion of works and handover to relevant stakeholders. ● The Zambezi Tongas are vulnerable and need the irrigation facilities and a dam that is operational. ● The dam is currently a safety hazard to the community. ● The environment was altered during construction. ● Review the access needs for the community.	● Rehabilitation measures included in the rehabilitation table and remedial measures ● Irrigation rehabilitation and commissioning recommended
Department of Social Welfare and	● Vulnerable persons must benefit from the infrastructure – female headed households, chronically ill, child headed	● Access road and irrigation infrastructure rehabilitation included in the ESMP

Community Development	households, aged and disabled. Ensure it is usable by all persons e.g. access routes, irrigation and water use. ● Men take part in most income generating activities including employment. ● Women and the vulnerable groups benefit more than men from the government's resource park through the department for gender equity. ● The project should involve employment of both men and women. ● The Zambia Police's Victim Support Unit VSU, Government Community Development deal in gender matters in the district. ● There have not been many local initiatives or programmes due to lack of funding. ● GBV is prevalent but most cases are hidden. ● Child labor is common. ● Continuous sensitizations are needed.	● Employment of locals and females recommended for compliance by the contractor ● GBV and child labor aspects are covered ● Sensitizations and training are planned for the community and contractor
Department of Forestry	● Afforestation and reforestation are vital for dam sustainability. ● The last contractor did not involve the department. ● They cleared the area unnecessarily leaving it unrestored. They cleared mature trees and they changed the entire landscape. ● Locals have to embrace tree planting and should undergo training. The new trend is cutting of smaller trees for garden fencing and tomato gardens. ● Southern Province is facing deforestation at a rapid pace and that threatens such projects and infrastructure. ● The Department has a number of indigenous seedlings for tree planting. ● The line ministries must be involved in the dam activities including through site visits as they have not been to the dam sites. That way, they will better contribute to the mitigation measures of the project. ● Communities must set up nurseries and avoid secondary clearing of land due to the dam usage. ● Gardens will cause siltation, this must be prevented. ● Catchment protection.	● The Department s of Forestry and Agriculture have been involved from the planning stage into the operation phase ● Sensitizations and training planned for the community and contractor ● Catchment management proposed ● UNOPS prepared technical and E&S Safeguards documents that will be disclosed to the public by IDSP

	• Increase in population will have impacts on flora. • Downstream area has a lot of impacts at present and it will in future. • The district has a disaster management committee which needs the EPP once it's done.	
Department of Agriculture	• The sites have sparse vegetation with significant disturbance to the natural ecosystem. • There needs to be wide sensitization of communities downstream. • Cutting of drains, silt traps and contour bands around the reservoir must be considered. • Ngolongozya Dam has siltation problems. Traps in the catchment area must be developed • The communities should be involved all the way to sustain the dams as their activities matter in the protection and conservation of nature. • Sensitization of good farming methods to be done.	• Sensitizations and training planned for the community
Community members	• The dam is not useful at the moment because construction was stopped. • It is for the Zambezi Tongas who were displaced from the Kariba Dam construction. • This is supposed to be an irrigation dam but that is not accomplished at the moment because structures are not there for irrigation. An outlet pipe is seen, but not functional. There are no canals. • Construction works disturbed the land and land use activities such as farming, arable soils and forests. These were not restored. • Material from several borrow areas around the dam was transported to the Zimba town for sale by the contractor. This has almost permanently destroyed the land. • The contractor did not follow labor laws. • The spillway is returning flows and is highly eroded. • There disturbed lands have caused sand movements especially downstream. This has led to these soils to move downstream	• The dam will be handed over to the district stakeholders and the community after completion of works • Dam use trainings are planned for • Inclusion of gender in dam construction employment has been included • Remediation and decommissioning of sites has been included to reduce and avoid vulnerability of the locals • The contractor's expected labor law compliance will be included in the bid documents with site supervision by the Engineer • Sensitizations and training planned for the community • Method statements have been proposed for the sites with detailed locations, methods

	and chock the stream. Water seeps into the sand. The communities downstream have to dig into the sand to get water. The sand also covered the old bridge close to the embankment. ● The communities use the embankment and spillway (too low/it floods) as the main road to the Zimba District. This is too narrow and water almost topped over in the last rainy seasons. Emergency outlets had to be opened. ● The dam still requires rehabilitation and completion of works in a proper manner to promote safety.	

9.3 Stakeholder Communication Plan

Information disclosure will rely on the following key methods: community meetings in coordination with local authorities (headmen, dam committee 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 Ngolongozya dam committee and the district disaster committee will be requested to inform communities in community meetings and through disclosure on social media where feasible.

Table 13 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, dam committee, 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, dam committee, 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, dam committee, 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, dam committee 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 during remedial works	ESMP	Community meetings with local headmen, dam committee, 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	Minutes of meeting Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Any works-related information (on activities, details of construction activities, labor)	Community meetings with local headmen, dam committee, 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, dam committee, 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 regards to the long term use	GRM	Community Meetings – with social distancing Community notice boards	DMC; 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).

Consultations during ESMP preparation

Table 14 Consultations during ESMP preparation

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, dam committees and district authorities	local headmen, dam committees and district authorities	UNOPS

Consultations planned for the implementation stage

Table 15 Consultations planned for the implementation stage

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures ESMP Disclosure Venue:	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	Dam Committee and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS
		Telephone Hotline	All stakeholders, including vulnerable groups	IDSP Social Specialist

	community meeting venue in the village or the school District council hall Time: to be agreed with the community and other stakeholders After document clearance and before construction works commence	Dam Committee, 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 designs for the Ngolongozya dam works developed, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Ngolongozya 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 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 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, PPE use, 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 Dam Committee 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 Ngolongozya 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 51:

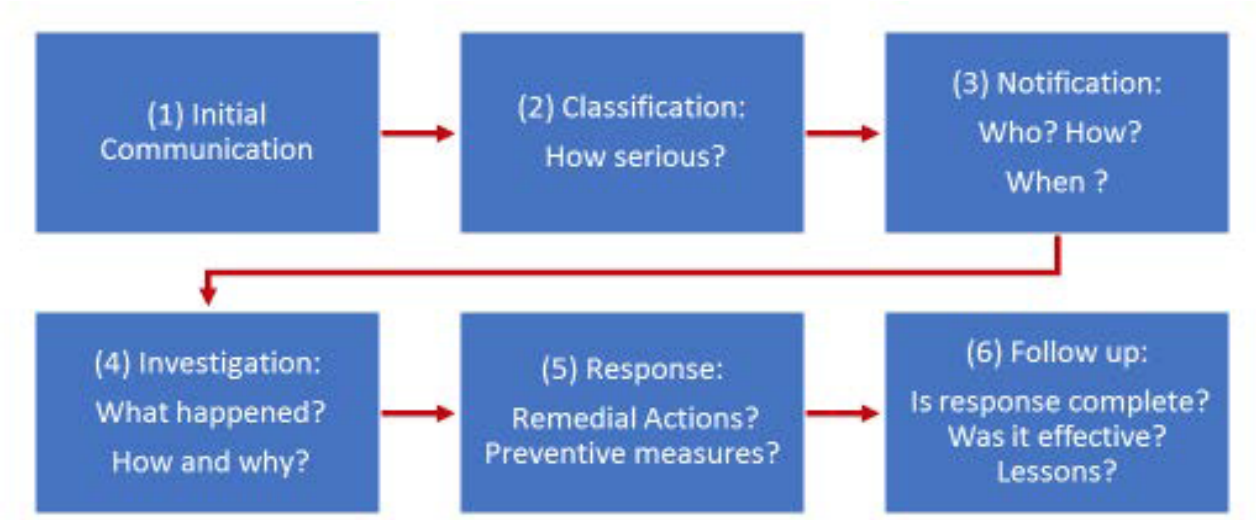


Figure 51 Incident reporting process

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 Ngolongozya dam committee 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.

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Appendix A: Completed Checklist

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

1-Date of the visit: 16th July 2020		
Name of the Environmental Specialist filling this checklist: Pilila Chongo		
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: Ngolongozya Dam		
Location Ngolongozya	**Region** Southern Province	**District** Zimba
Villages /communities	Ngolongozya	
Geographical location	**Coordinate South** -17.368394° ; S	**Coordinate East** 26.539848°. E
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Slope works	Material sourcing	Access routes, embankment raising
Outlets	Erosion/ soil loosening	Spillway
Infiltration	Site preparations/ clearing	Irrigation canal
Other	Waste management	Seepage

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

Contractors/builders	, and Zimba Town	
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 slopes, open sites and around the dam Minimized disturbance of forest cover
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
Water:	Maintain water quality during works and minimize further siltation in the basin Construct VIP toilet an safely decommission
Roads:	Rehabilitate roads after works Promote community health and safety Embankment access works
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: Campsite	Rehabilitation of existing site

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)**	- Rehabilitation of former campsite
o **Hazardous wastes (diesel containers, old machinery, batteries, paints, metals, contaminated waters or soil,**	-

o **Borrow pits**	Decommissioning and rehabilitation of several borrow areas
o **Unsafe paths**	Rehabilitation of former contractor roads Construction of crossing
o **Unfinished crossing points for communities**	Crossing point over the spillway and embankment is not safe Construction of animal watering points around the basin
o **Other: Environmental flows and outlets**	Inclusion of outlets, flow monitoring gauges, rehabilitation of seepage points
8- Ecological Flow. Have you to coordinate with the technical team the options to improve ecological flows below the dams 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: Yes (indicate below species)** The initial assessment using IBAT indicates presence of species that may be endangered or may require special attention. The full biodiversity assessment was conducted and a BMP is annexed.
Are people using the water below the dam? What for?	Not all year round. Only in rain season when there are downstream flows
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. **(Refer to the annexed BMP)**	
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 Action Plan (BAP) **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 (BEMP)**	
10-Final recommendation	
Name Pilila Chongo,	**Date: 20 July 2020**
Signature P.C	
Comments for the preparation of the ESMP and BAP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys *This section will be updated after the Biodiversity Assessment*	
Field visits registration	

Photo **Environmental damage-land degradation of the whole site** 	Photo ‘

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[29]

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.

[29] 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.

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
    - 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 Sheets Stakeholder Consultations and Dam Committee List

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE: NGOLONGOZYA DAM, ZIMBA DATE: 14/07/20

ZIMBA DISTRICT OFFICERS

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
1	CLEMENT KATUNGWA	M	AGRIC ASST	MOA	0977789877	
2	CHRISTINA MWABA	F	DFO	MLNR	0978 66 64 40	
3	BRIDGES M. BANDA	F	DCDO	DEP. OF COMMUNITY	0977558308	
4	ELIZABETH KALABULA	F	DA	DC	0977 428010	
5	KUNDU MULELA BSH	M	ACDO	COM. DEV	0966 401325	

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE NGOLONKOZYA DAM DATE 14/07/20

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
1	CLEMENT KAYUNGWA	M	AGRIC ASS.	MINISTRY OF AGRI	0977799377	
2	PICKSON SIAKEEKA	M	HEADMAN	FARMER	0977544673	
3	MACKSON MAAMBO	M	C. MEMBER	FARMER	0973259411	
4	BENARD HAWAILE	M	C/PERSON	Farmer	0971599883	
5	LUCIA SINAMUKUNGA	F	TREASURE	Farmer	0956953615	
6	RONESS SIAKAYAYA	F	Member	farmer	0977118131	
7	BETTY SIAMUCHE	F	member	Farmer		
8	POLINA SIABUSIKA	F	member	Farmer		
9	JAMES SIKATI	M	Member	farmer	0979101192	
10	KENNETH SIMAVWINDA	M	Member	Farmer	0972561989	
11	SAMSON JOSEPH	M	Member	farmer		
12	CORENCE CHASEKELA	M	member	farmer	0971632250	
13	EUNICE SIANENGE	F	Member	Farmer	0977118160	
14	DANIEL KAYUMBA	M	KAYUMBA	Headman		
15	MINIZULU SIMAVWINDA	M	C/Member	Red cross	0972756091	
16	CHARLES MALINGA	M	Headman	malinga	0950263779	
17	GIDEON SIANKUNI	M	MEMBER	FARMER	0975158642	
18	DOMINAH SIKAATE	F	MEMBER	farmer		
19	DALESS SIAMWAMWA	F	Member	farmer		
20	LAWRENCE MAGAYA	M	Member	farmer	0955923260	
21	BWALYA NDOMBE	M	member	Farmer	0976264763	

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE NGOLONGOZYA DAM DATE 14/07/20

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
22	Kinosty NDoombe	M	~~Exec~~ member	Farmer	0950928203	K. NDoombe
23	Hiladi Chasekela	M	Member	Farmer	"	W. C

NGOLONGOZYA DAM
LIST OF COMMITTEE MEMBERS

NAME	GENDER	POSITION	PHONE NUMBER
BERNARD HAWAILE	M	CHAIR PERSON	0971599883
MACKSON MAAMBO	M	COMMITTEE MEMBER	0973258411
KIWI S. SIANTENDA	M	SECRETARY	0975078473
CLEMENT KAYUNGWA	M	VICE SECRETARY	0977789877
LUCIA SINAMUKUNGA	F	TREASURER	0972247140
NEVIKULED SIAMUCHE	M	VICE CHAIRPERSON	0953939223
RONESS SIAKAYAAYA	F	COMITTEE MEMBER	0954872876
DAILES SIAMWAMVUA	F	COMMITTEE MEMBER	0771138093
CHRISTETOR SIANCHILI	F	COMMITTEE MEMBER	0777118171
MONETY SIAMWELA	F	COMMITTEE MEMBER	0978697436

Appendix G: 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	Other (please specify)		Other (please specify)

Management			

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 H: 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 ESMP by contractor to site accessing persons *Environmental management plans* *GRM*	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

The project area of influence has three main types of terrestrial habitats. These are Miombo Woodlands which is punctuated by sporadic Termitaria habitats; Dambos (Shallow Wetlands); and Riverine or Riparian Habitats. Generally, all of these habitats have been greatly disturbed by anthropogenic activities such as agriculture, charcoal production and settlements.

A total of 32 terrestrial tree species were observed in the sampled area (25,136m^2) around Ngolongozya Dam. In this area, a total of 567 stems were recorded. *Julbernardia globiflora* had the highest number of stems with 87 followed by *Combretum zeyheri* with 56 and *Baphia bequaertii* with 42 stems.

In terms of dominance, *Julbernardia globiflora* had the highest Importance Value (IV) of 41.8% followed by *Combretum zeyheri* (39.8%), *Albizia Harveyii* (25.2%) and *Terminalia brachystemma* with 23%. This is an indication that the three species are the most dominant within the project area of influence.

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

Due to human settlements, an agricultural activity, charcoal production and hunting, the subproject is devoid of large fauna. Twenty five (25) species of terrestrial mammals were observed during the survey with the most common one being: Scrub Hare, *Lepus saxatilis*; Tree Squirrel, *Paraxerus cepapi*; Vervet Monkey, *Cercopithecus aethiops*; Dwarf Mongoose, *Helogale parvula*; Climbing Mouse, *Dendromus melanotis*; and Field Mouse, *Apodemus sylvaticus*. No terrestrial mammals have a conservation status of concern per the IUCN Red List.

Regarding reptiles, twenty two (22) species were recorded. Reptiles in the area are dominated by lizards and snakes. Most common reptiles in the area are: Bushveld Lizard, *Heliobolus lugubris*; Flap-Necked Chameleon, *Chamaeleo dilepis*; Striped Skink, *Trachylepsis striata*; Southern Rock Agama, *Agama atra*; Tree Agama, *Acanthocerus atricollis;* 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*; and Marsh Terrapin, *Pelomedusa subrufa.*

Because of the presence of water and dambos, the sub-project site hosts an array of birds. The study recorded 81 bird species within the project area of influence.

None of the reptiles and birds species are listed as Near Threatened, Threatened, Endangered, or Critically Endangered under the IUCN Red List.

During the survey, a total of eleven (11) amphibian species were encountered or observed. These were all frogs and toads. All the recorded amphibians are listed as Least Concern under the IUCN Red List.

Based on Kleynhans (1996) tool for habitat integrity assessment, which considers changes as regards instream and riparian characteristics, modifications have occurred at Ngologozya Dam. The downstream area has been largely modified with respect to the aforementioned characteristics due to being starved of environmental flows.

A total of 17 phytoplanktons and 24 zooplanktons were ascertained in the water samples obtained at Ngologozya. 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 especially with respect to conductivity was noted. Chemical analysis of water samples done in the laboratory at the University of Zambia, showed low levels of fertilizer constituents. This could be indicative of low usage of fertilizer in the fields by the dam or alternatively high dilution capacity of the dam at the time of conducting this survey.

With regards to fish species, eight are present at Ngologozya. These include *dashtail barb (Barbus poechii), Three spotted tilapia (Oreochromis andersonii) Red breasted tilapia (Coptodon rendalli) Banded tilapia* (*Tilapia sparmanii*) (LC), Bulldog (*Marcusenius macrolepidotus)* (LC) *Green headed Tilapia (Oreochromis machrochir*), Sharptooth catfish (*Clarias gariepinus)* and a *cross (Oreochromis machrochir & Oreochromis andersonii)*. As regards to IUCN conservation status, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Ten invertebrates were encountered. Namely: dragon flies (*Anisoptera sp*,) horse fly (*Tabanus bovinus*), mosquitoes (*Aedes sp)*, midges (*Chironomus sp.)*, whirligig beetles (*Gyrinus natator),* water boatman (*Corixidae sp.)*, water strider (*Gerridae sp),* Mayfly (*Baetidae),* crab (*Potamonautidae sp)* (, Snails (*Gastropod sp)*.

Aquatic plants encountered were 6, including bullrush (*Typha angustifolia),* Filamentous algea (*Pleurastrum terricola)* cattail *(Typha latifolia)*, Giant reeds (*Phragmites sp*.), and smartweed *(Polygonum pensylvanicum*).

With respect to IUCN conservation status, all the invertebrates and aquatic plants are of least concern.

Predicted Project Impacts

The project impacts on flora and fauna during the construction works for the remediation of the dam will be mainly due to clearing for access roads, worker's 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 cattle. 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.

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 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:

- 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;
- 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 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 dam committee 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.

1. INTRODUCTION

Ngolongozya Dam is located in Zimba District of Southern Province. It is an earth fill dam that was constructed on the Ngolongozya River in 2016. The dam is about 36 km from the Zimba urban centre at GPS coordinates S17.36850° and E26.53992°. The main purposes of the dam are aquaculture as well as provision of water for irrigation and livestock within the project area of influence.

With the dam wall height at 10.5m, Ngolongozya Dam is classified as a small dam (dam wall height less than 15m) under the OP 4.37 guidelines. The dam is one of the ten dams that have been selected for remedial works under the World Bank (WB) funded Irrigation Development Support Project (IDSP).

A mid-term review of the sub-project found a number of non-compliance issues including inadequate construction performance. This means the integrity of the existing structures at the dam is compromised. This condition makes Ngolongozya Dam a threat to the local community, downstream users and the environment at large. To ensure safety and compliance with laws and WB safeguards policies, remedial works are to be done on the dam infrastructure. UNOPS has been tasked to prepare this BMP in addition to an ESMP on behalf of the GRZ to guide the remedial works including mitigation of identified imminent risks to the environment, safety of communities, and their associated livelihoods.

UNOPS has already conducted environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders. Initial field screening visits by the UNOPS team revealed that an in-depth biodiversity assessment of the project area of influence is required. In-depth Biodiversity Assessment (BA) of the site has been done. The BA is presented in this report together with the Biodiversity Management Plan (BMP).

Remedial dam construction works will commence after ESMP and BMP approval by the World Bank. Those two documents will be publicly disclosed and communicated to the stakeholders prior to the commencement of remedial works. Remedial dam construction work is anticipated to take 6 months.

Objectives of the BDA

Overall Objective

The overall objective of this BMP is to guide the remedial works on Ngolongozya 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.

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 Assessments

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 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.

Assessment Methodology

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

Terrestrial

This dam is considered a 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. In order to determine the dam's area of influence, its estimated throwback was used. For the purpose of this study, the estimated throwback used was 1.8Km which was adopted from studies done by COWI in 2018. Taking the dam's throwback as the 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 influence. Google Earth images were used in this regard. Using this method, the determined area of influence for Ngolongozya Dam is shown in Figure 3-1. Sampling was done within the determined area of influence.

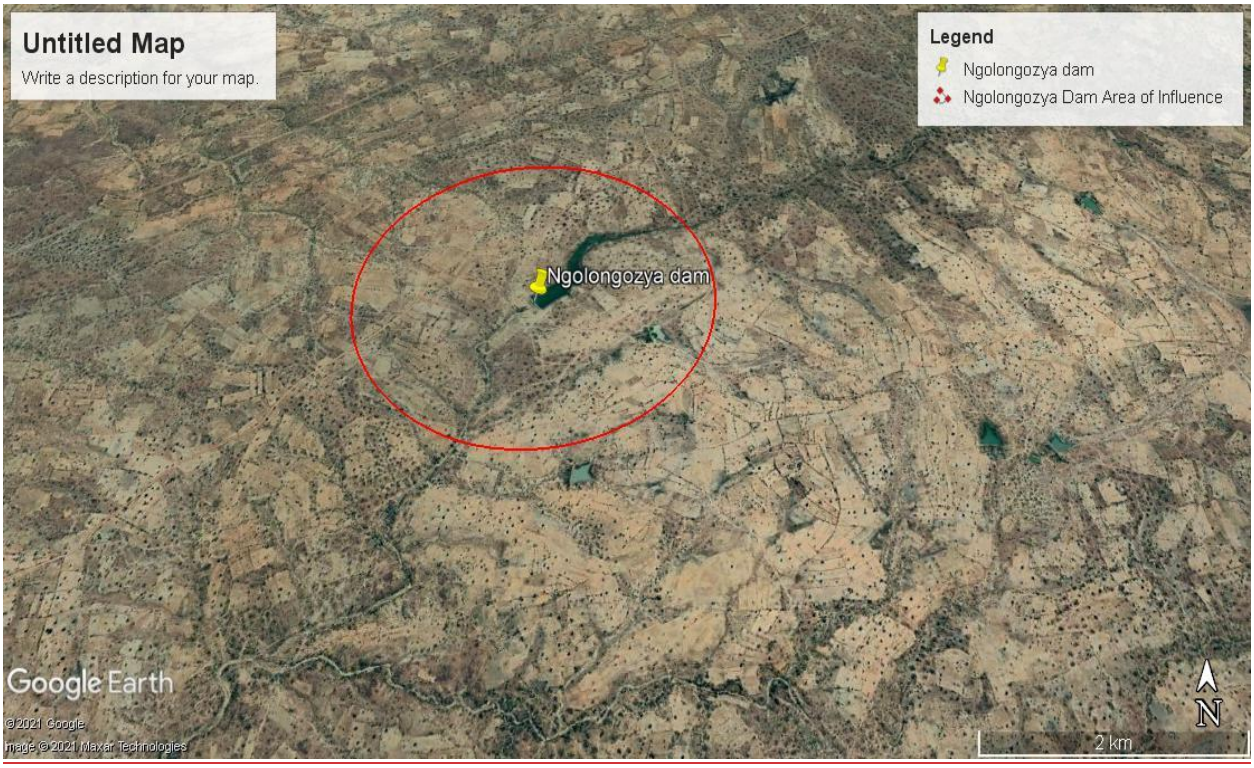


Figure 52 Ngolongozya Dam area of influence

Aquatic

This dam is considered as category B project, the direct area of influence for the aquatic 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 project 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 this study, to determine the value or integrity of terrestrial habitats, the criteria shown in Table 16 were adopted. Vulnerability of receptors was determined by employing the IUCN conservation status/value.

Table 16 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.

Table 17 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.

Photographs were used to show the condition of the site, structures and surrounding habitats.

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[30] (1996) was employed. Vulnerability of receptors was determined by employing the IUCN conservation status/value. Table 18 shows the criteria used for aquatic habitat integrity assessment.

Table 18 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
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.

[30] Kleynhans developed his habitat integrity index by using it on riparian and in stream habitats. Ngolongozya 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.

Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous 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 19.

Table 19 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 20 Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Flow modification	13	Indigenous 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 integrity assessment. The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 21.*

Table 21 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 22 presents the terminology used to describe and rank environmental and social impacts according to the categories defined above.

Table 22 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 sub-project site Outside the sub-project site but <20 km away Outside the sub-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 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 Project, but which has a connection with the 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.	

Photographs were used to show the condition of the site, structures and surrounding habitants.

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.

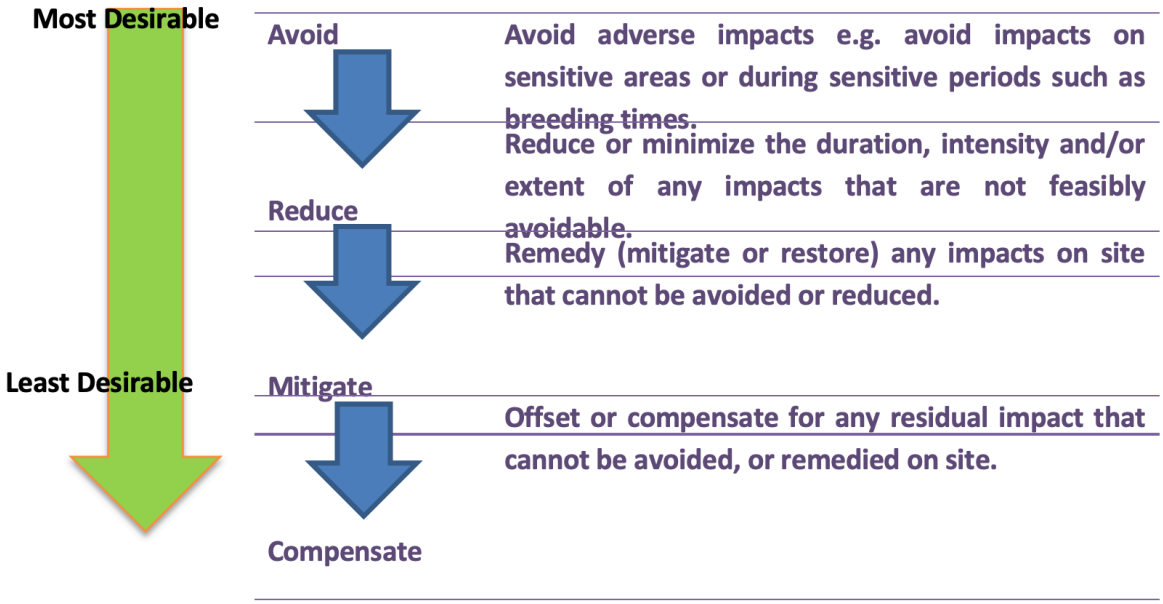


Figure 53 Impact Mitigation hierarchy adopted

Data collection methods

Desk review

Before undertaking site surveys, a desk study was done. The purpose of the desk review was to help develop the study methodology and prepare for field work. The review 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 Ngolongozya 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

The field surveys 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.

Terrestrial field surveys for flora and fauna were done concurrently for 3 days, i.e. on 8th, 9th and 12th of April, 2021.

Flora surveys

In order to carry out an effective flora survey, a blend of sampling methods was used. These were Stratified Random Sampling; Purposive Sampling and Point Counts. Stratified random sampling was preferred because it was observed that 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 fields and other crops' gardens) and settlements within the project area of influence have further fragmented the site. In order to assess vegetation in all the areas (upstream and downstream as well as Eastern and Western sides of the Dam), across all habitat types, and in the available fragmentations, strata were made following these groups. Sampling in these strata was randomly done.

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

Because the study also aimed at establishing whether the sub-project site host species of interest, point count was considered. This would come into play when or if species of interest are observed outside the set sampling plots or while traversing the study area.

In total, 20 sampling plots were established. These plots were circular and had a radius of 20m translating into an approximate overall sampled area of 25,120 per plot. 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 coordinates for the locations of the sample plots is given in Appendix 1.

Table 23 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 23 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, Technician 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 24).

Table 24 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 centre 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 (Appendix 3).

Fauna assessment

To study fauna on site, assessments were conducted in all the habitat or vegetation types observed within the project area of influence. In line with this, the number of fauna survey sites reflected the number of vegetation communities or habitats present within the study area.

The locations of the fauna survey sites were determined from vegetation community identified during the reconnaissance survey and from available maps prior to the commencement of detailed surveys.

The main terrestrial fauna habitats in the project area of influence are Miombo Woodlands, Riverine Vegetation (Riparian), and Dambos (willow wetlands). Miombo Woodland are the most wide spread in terms of extent. Within the Miombo Woodlands on site, there are sporadic specialised Termitaria or Anthills habitats. Occurring habitat types were defined based on the findings from the vegetation investigations. The different types of vegetation or habitats present in the project are shown in Figure 54.

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. 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)

a). Rejuvenating miombo woodlands on site

b). Dambo (Shallow wetland on site)

Termitaria habitat

Figure 54 Main habitats on site in which fauna surveys were conducted

Figure 55 Small mammal trapping using (a) 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 field for two days and nights. Figure 56 shows the cameras set in the field. The cameras were set at knee height so that even small fauna can be captured.

Figure 56 Field camera trap for fauna observation

Regarding invertebrates, observations 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 Ngolongozya 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 57 shows a focus group discussion held with members of the DMC regarding wildlife in the area.


Figure 57 Group interview with members of the Ngolongozya 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 at Ngolongozya for 3 days. That is on the 8th, 9th and 12th of April, 2021. On the first day, aside from collecting data on water quality, plankton, 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 Ngologozya Dam on 8th 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, plankton and habitats for the area under review. The coordinates for sampling points are indicated in table 25. Data captured at each one of the sampling points were recorded on the attached data sheets (Appendix 6).

Table 25 Coordinates for the points sampled

Coordinates		Location Description
S17.36924 degrees	E026.53956 degrees	Downstream
S17.37075 degrees	E026.51859 degrees	At the weir
S17.38683 degrees	E026.64468. degrees	Mid-section of reservoir
S17.36017 degrees	E026.54622 degrees	Point of entry of stream into reservoir
S17.35992 degrees	E026.55047 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.

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 plankton; 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 a 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 Carruthers (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 a 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 DMC 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, plankton and habitats. This section provides a breakdown of how the data were 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

The study established that the Ngolongozya Dam area has three general types of habitats. These are Miombo Woodlands which are punctuated by sporadic Termitaria habitats; Dambos (Shallow Wetlands); and Riverine or Riparian Habitats (Figure 3-3). Generally, all of these habitats have been greatly disturbed by anthropogenic activities. Due to this fact, most of the trees in Miombo Woodlands have DBHs less than 12cm.

Dambos of interest within the dam's catchment area and area of influence have been marked, their coordinates recorded and presented in Appendix 5 for conservation purposes

In terms of value or importance, the three main habitats are classified in Table 26, with reasons for the classification given.

Table 26 Importance or values of habitats on site

Type of Habitat		Classification Value (importance)	Reasons for Classification
1	Miombo Woodlands		
	General Miombo	Low	Vegetation clearing and tree cutting for agricultural purposes;

	Woodland		fencing of cattle kraals and gardens; and kilning of bricks has resulted in loss of mature tree stems and habitat fragmentation (Figure 4-1a, b and c) Vegetation cover is poor with most trees having DBH less than 10cm. In fact the Miombo Vegetation in the area is just rejuvenating (Figure 3-3a) North Eastern side of the dam has been mostly cleared for settlements
	Termitaria	Low	The host of this type of habitats, Termite Hills, have been highly disturbed and in some cases totally wiped due to block making using their soils (Figure 4-1c)
2	Riparian or Riverine	Low	Riverine vegetation has been disturbed by gardening on the banks of the stream Acacia, which is the dominant tree species in this habitat, is heavily exploited for fencing of gardens. This is because its thorns act as a deterrent to intruders that include people and cattle
3	Dambos	Low	Dambos are being heavily exploited for cattle grazing hence their ability to retain or collect water has been greatly lessened (Figure 4-1d)

From the field observations, the **quality or value of habitats** in the area of influence for Ngolongozya Dam is **Low.** This is attributed to anthropogenic activities such as settlements; agriculture; garden fencing and making of kraals; cattle and goats grazing; and Termite Hill Soil brick making.

a). Agriculture – Maize field

b)Trees cut for charcoal production and brick kilning

c). Bricks made from termite hill soils

d). Cattle grazing in a dambo

Figure 58 Land uses contributing to habitats' degradation

Flora

To undertake a flora survey for Ngolongozya Dam's area of influence, 20 circular plots with a radius of 20m were established. This represents a total sampled area of 25,136m^2 or 2.51ha.

The total number of tree species recorded in the sampled area was 32 with an overall stem count of 567. The total number of stems recorded in the sampled area translates into 226 Stems/ha. This represents a scanty forested area. Further, the average tree DBH recorded was 9.84cm attesting to the heavy vegetation exploitation or clearing.

Julbernardia globiflora had the highest number of stems with 87 followed by *Combretum zeyheri* with 56 and *Baphia bequaertii* with 42 stems.
The Relative Frequency, Relative Density, Abundance, Relative Basal Area, and 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

From the results of data analysis, Julbernardia *globiflora* had the highest IV (41.8%) followed by *Combretum zeyheri* (39.8), *Albizia Harveyii* (25.2%) and *Terminalia brachystemma* with 23%. The four species with the least IV were: *Parinari Curatellifolia* (3.8%); *Berchemia discolor* (4.01%); and *Dombeya rotundifolia* and *Cassia abbreviate* (both 4.1%).

From the analysis, the conclusion is that *Julbernardia globiflora*, *Combretum zeyheri*, *Albizia Harveyii* and *Terminalia brachystemma* are the most dominant, common and abundant tree species within the Ngolongozya Dam's area of influence.

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

Table 27 Relative frequency, relative density, relative basalarea and IV

	Species Name	No. of stems	Relative Frequency	Relative Density	Abundance	Relative Basal Area	Importance Value	IUCN Status
1	*Jubernadia globiflora*	87	27.3	14.3	9	0.2	41.8	LC
2	*Lannea stuhlmannii*	10	9.1	1.8	3.3	0.01	10.91	LC
3	*Bridelia micrantha*	8	6.1	1.4	4	0.08	5.6	LC
4	*Terminalia brachystemma*	26	18.2	4.6	4.3	0.2	23	LC
5	*Cassia abbreviata*	4	3.1	1	4	0.01	4.1	LC
6	*Pterocapus rotundifolia*	4	6.1	1	2	0.02	7.1	LC
7	*Combretum molle*	16	12.1	2.8	4	0.09	15	LC
8	*Baphia bequaertii*	42	9.1	7.4	14	0.1	16.6	LC
9	*Piliostigma thonningii*	39	9.1	6.9	13	0.1	16.1	LC
10	*Acacia polycantha*	12	12.1	2.1	4	1.1	15.3	LC
11	*Albizia harveyii*	38	15.2	6.7	7.6	3.3	25.2	LC
12	*Diosspyroos kirkiI*	6	6.1	1.1	3	0.3	7.5	LC
13	*Bauhinia petersiana*	11	9.1	1.9	3.6	1.2	11.3	LC
14	*Berchemia discolor*	3	3.0	1	3	0.01	4.01	LC
15	*Acacia sierberana*	10	9.1	1.8	3.3	1.2	12.1	LC
16	*Dichrostachys cinerea*	8	6.1	1.4	4	0.3	7.8	LC
17	*Markhamia obtusifolia*	4	25	1	4	0.1	6.1	LC
18	*Podocarpus milanjianus*	6	6.1	1.1	3	0.06	7.3	LC
19	*Brachystegia boehmi*	9	9.1	1.6	6	0.05	10.8	LC
20	*Combretum imberbe*	33	9.1	5.8	11	0.05	15	LC
21	Parinari curatellifolia	5	3.0	0.8	5	0.01	3.8	LC
22	*Ozorda reticulata*	9	6.1	1.6	4.5	0.08	7.8	LC
23	*Combretum zeyheri*	56	24.2	9.8	7	5.8	39.8	LC
24	*Strichnos cocculoides*	8	3.0	1.4	8	0.01	4.4	LC
25	*Dombeya rotundifolia*	6	3.0	1.1	6	0.02	4.1	LC
26	*Diplorhynchus condylocarpon*	10	6.1	1.8	5	0.02	7.9	LC

27	*Trema orientalis*	7	6.1	1.2	3.5	0.01	7.3	LC
28	*Peltophorum africanum*	4	3	1	4	1.3	5.3	LC
29	*Acacia tortilis*	35	9.1	6.2	11.6	0.1	15.4	LC
30	*Combretum mechowianum*	23	12.1	4	5.8	0.02	16.1	LC
31	*Ziziphus abyssinica*	16	9.1	4.1	5.3	0.05	13.3	LC
32	*Vitex doniana*	12	9.1	2.1	4	0.2	11.4	LC
Totals		**567**						

Frequency refers to the degree of dispersion in terms of percentage occurrence (Shukla and Chandel 2000). The species that are 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 (Table4-3).

Table 28 Abundance classes for sampled tree species

	Species Name	Relative Frequency	Abundance Classes
1	*Jubernadia globiflora*	27.3	Frequent
2	*Markhamia obtusifolia*	25	Frequent
3	*Combretum zeyheri*	24.2	Frequent
4	*Terminalia brachystemma*	18.2	Frequent
5	*Albizia harveyii*	15.2	Frequent
6	*Combretum molle*	12.1	Occasional
7	*Acacia polycantha*	12.1	Occasional
8	*Combretum mechowianum*	12.1	Occasional
9	*Lannea stuhlmannii*	9.1	Occasional
10	*Baphia bequaertii*	9.1	Occasional
11	*Piliostigma thonningii*	9.1	Occasional
12	*Bauhinia petersiana*	9.1	Occasional
13	*Acacia sierberana*	9.1	Occasional
14	*Brachystegia boehmi*	9.1	Occasional
15	*Combretum imberbe*	9.1	Occasional
16	*Acacia tortilis*	9.1	Occasional
17	*Ziziphus abyssinica*	9.1	Occasional
18	*Vitex doniana*	9.1	Occasional
19	*Bridelia micrantha*	6.1	Occasional
20	*Pterocapus rotundifolia*	6.1	Occasional
21	*Diosspyroos kirkil*	6.1	Occasional
22	*Dichrostachys cinerea*	6.1	Occasional
23	*Podocarpus milanjianus*	6.1	Occasional
24	*Ozorda reticulata*	6.1	Occasional
25	*Diplorhynchus condylocarpon*	6.1	Occasional
26	*Trema orientalis*	6.1	Occasional
27	*Cassia abbreviata*	3.1	Rare
28	*Berchemia discolor*	3	Rare
29	Parinari curatellifolia	3	Rare
30	*Strichnos cocculoides*	3	Rare
31	*Dombeya rotundifolia*	3	Rare

32	*Peltophorum africanum*	3	Rare

From the analysis of the obtained data, no plant species in the area can be classified as either abundant or Very Abundant. This also attests to the fact that the vegetation in the area has highly been disturbed by anthropogenic activities. However, from the obtained results, the most widespread tree species in the area is *Julbernardia globiflora* with a relative frequency of 27.3%, followed by *Markhamia Obtusifolia 25%)* while *Combretum zeyheri* was third with 24.2%. These were followed by *Terminalia brachystemma* (18.2%), *Albizia Harveyii* (15.2%) *and Combretum molle* (12.2%). Other species with a Relative Frequency of 12.1% were *Acacia Polycantha and Combretum mechowianum.* From the results, *Combretum* species are by far the widest spread trees in the area.

In terms of stockings or number of stems per given area, the extrapolated value for the whole sampled area was 226 Stems/ha. This indicates a low stocking or degraded Miombo as high value Miombo Woodlands usually have the stocking of at least 500 Stems/ha. Regarding specific species stocking, *Julbernardia globiflora* was the highest with 35 Stems/ha followed by *Combretum zeyheri* (23 Stems/ha) and *Baphia bequaertii* (17 Stems/ha). Extrapolated number of Stems per hectare for all observed tree species is shown in Table 29.

Table 29 Stems per hectare for all tree species observed

Species Name	No. of stems	Stems/Hectare
Jubernadia globiflora	87	35
Combretum zeyheri	56	23
Baphia bequaertii	42	17
Piliostigma thonningii	39	16
Albizia harveyi	38	16
Acacia tortilis	35	16
Combretum imberbe	33	14
Terminalia brachystemma	26	11
Combretum mechowianum	23	10
Ziziphus abyssinica	16	7
Combretum molle	16	7
Vitex doniana	12	5
Acacia Polycantha	12	5
Bauhinia petersiana	11	5
Lannea stuhlmannii	10	4
Diplorhynchus condylocarpon	10	4
Acacia sierberana	10	4
Ozorda reticulata	9	4
Brachystegia boehmi	9	4
Strichnos cocculoides	8	4
Dichrostachys cinerea	8	4
Bridelia micrantha	8	4
Trema orientalis	7	3
Podocarpus milanjianus	6	3

Dombeya rotundifolia	6	3
Diosspyroos kirkiI	6	3
Parinari curatellifolia	5	3
Pterocapus rotundifolia	4	3
Peltophorum africanum	4	3
Markhamia obtusifolia	4	3
Cassia abbreviata	4	3
Berchemia discolor	3	3
Totals	**567**	226

Regeneration: A total number of 36 species were noted under regeneration with a combined number of stems of 1,322. In terms of stocking, regeneration across the sampled area was at 527 Stems/ha showing a health rejuvenation rate. Regarding specific species, *Julbernardia Globiflor* had the highest number of wildlings' stems recorded with 139. It was followed by *Combretum zeyheri* with 113 stems while *Terminalia brachystemma* was third with 91 stems of wildlings. *Dombeya rotundifolia* had the least number of wildlings recorded (7) while *Ekebergia benguelensis* was second lowest with 8 wildling stems. *Bridelia micrantha* and *Strichnos spinose* both had 9 stems of wildlings in the sampled area. The full regeneration results and corresponding stocking for all observed species under regeneration is presented in Table 30.

Table 30 Regeneration in sampled area

	Species Name	No. of regeneration stems	Stems/ha	IUCN Status
1	*Julbernardia globiflora*	139	56	LC
2	*Combretum zeyheri*	113	46	LC
3	*Terminalia brachystemma*	91	37	LC
4	*Brachystegia boehmi*	89	36	LC
5	*Acacia polycantha*	87	35	LC
6	*Albizia versicolor*	57	23	LC
7	*Combretum fragrans*	53	22	LC
8	*Albizia harveyi*	50	20	LC
9	*Piliostigma thonningii*	50	20	LC
10	*Diplorhynchus condylorpon*	44	18	LC
11	*Dichrosachys cinerea*	43	18	LC
12	*Lannea stulhmannii*	38	16	LC
13	*Strichnos coculoides*	38	16	LC
14	*Brachystegia floribunda*	37	15	LC
15	*Ochna pulchra*	34	14	LC
16	*Vitex doniana*	28	12	LC
17	*Uapaca kirkiana*	28	12	LC
18	*Acacia tortilis*	27	11	LC
19	*Cassia abbreviata*	25	10	LC
20	*Faurea speciosa*	23	10	LC

21	*Pterocarpus lucens*	22	9	LC
22	*Pterocarpus angolensis*	21	9	LC
23	*Terminalia mollis*	21	9	LC
24	*Balanites aegyptiaca*	21	9	LC
25	*Peltophorum africanum*	16	7	LC
26	*Acacia sieberana*	16	7	LC
27	*Steganothenia araliacea*	15	6	LC
28	*Bauhinia petersiana*	14	6	LC
29	*Berchemia discolor*	14	6	LC
30	*Parinari curatellifolia*	13	6	LC
31	*Diospyrus Kkrkii*	11	5	LC
32	*Trema orientalis*	11	5	LC
33	*Strichnos spinosa*	9	4	LC
34	*Bridelia micrantha*	9	4	LC
35	*Ekebergia benguelensis*	8	4	LC
36	*Dombeya rotundifolia*	7	3	LC
Totals		**1322**	**526.69**	

Fauna

Mammals in the project area of influence

A total of 25 mammal species were recorded within Ngolongozya Dam's area of influence. The species that were physically encountered during the survey were: Scrub Hare, *Lepus saxatilis*; Tree Squirrel, *Paraxerus cepapi*; Vervet Monkey, *Cercopithecus aethiops*; Dwarf Mongoose, *Helogale parvula*; Climbing Mouse, *Dendromus melanotis*; and Field Mouse, *Apodemus sylvaticus*.

Observed signs of occurrence for mammals in the project area of influence are shown in Figure 59. The full list of Mammals recorded in the project area of influence is presented in Table 31.

Dwarf Mongoose, *Helogale parvula* scat

African pygmy mouse, *Mus minutoides*

Common Mole-Rat, *Cryptomys hottentotu* Four-toed hedgehog, *Atelerix albiventris burrowing*

Figure 59 Signs of mammal occurrence observed in the project area of influence

Table 31 List of mammals recorded in the area

No.	Scientific Name	Common Name	IUCN Status
1	*Rhabdomys pumilio*	African striped mouse	LC
2	*Dendromus melanotis*	African climbing mouse	LC
3	*Apodemus sylvaticus*	Field mouse	LC
4	*Lepus saxatilis*	Scrub hare	LC
5	*Xerus inauris*	Bush squirrel	LC
6	*Paraxerus cepapi*	Tree squirrel	LC
7	*Cercopithecus aethiops*	Vervet monkey	LC
8	*Helogale parvula*	Dwarf mongoose	LC
9	*Genetta genetta*	Common genet	LC
10	*Felis lybica*	African wild cat	LC
11	*Cryptomys hottentotus*	Common mole-rat	LC
12	*Otolemur crassicaudatus*	Thick-tailed Bush-baby	LC
13	*Sylvicapra grimmia*	Common duiker	LC
14	*Phacochoerus aethiopicus*	Warthog	LC
15	*Thryonomys swinderianus*	Greater cane rat	LC
16	*Vulpes chama*	Fox	LC
17	*Hystrix cristata*	Porcupine	LC
18	*Rattus rattus*	Black rat	LC
19	*Cryptomys mechowi*	Giant mole rat	LC
20	*Cryptomys hottentotus*	Common mole Rat	LC
21	*Philantomba monticola*	Blue duiker	LC
22	*Canis adustus*	Side-striped Jackal	LC
23	*Papio ursinus*	Chacma baboon	LC
24	*Civettictis civetta*	African civet	LC
25	*Mellivora capensis*	Honey badger	LC

4.1.3.2 Reptiles

During site surveys, the reptiles encountered in the field were: Bushveld Lizard, *Heliobolus lugubris* (Figure 4-3); Flap-Necked Chameleon, *Chamaeleo dilepis*; Striped Skink, *Trachylepsis striata*; Southern Rock Agama (Agama atra) and Tree Agama (Acanthocerus atricollis.

The full list of reptiles encountered, signs of occurrence noted and those reported to have been encountered by the interviewed local people is presented in Table 4-7.

Figure 60 Bushveld Lizard, Heliobolus lugubris

Table 32 Reptiles observed and those reported to have been sighted by community members

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

4.1.3.3 Birds

The study established that there is high avifauna biodiversity within the dam's area of influence. This is owing to the fact that within the considered area of 10.2Km^2, eighty one (81) different bird species were observed within three (3) days. The high number of bird species in the area is partly attributed to the presence of water in the dam. In line with this, numerous bird species were observed and/or there calls (sounds) heard. Figure 4-4 shows some of the signs of presence of birds observed in the project area of influence.

The full list of birds observed, heard, whose signs of occurrence were noted and those that have been seen by local people who were interviewed during the survey period is presented in Table 4-8.

Black Smith lapwing, *Vanellus armatus*

Egg shell of Guinea fowl, *Numida meleagris*

Eggs of Laughing dove, *Spilopelia senegalensis*

Nest of Laughing dove, *Spilopelia senegalensis*

Nest of Bronze mannikin, *Spermestes cucullata*

Nest of a Village weaver, *Ploceidae cucullatus*

Figure 61 Signs of bird species occurrence noted on site

Table 33 List of birds observed and sounds heard in the area. The list also includes birds reported by community members

No	Scientific name	Common name	IUCN Status
1	*Spermestes cucullata*	Bronze mannikin	LC
2	*Numida meleagris*	Guinea fowl	LC
3	*Spilopelia senegalensis*	Laughing dove	LC
4	*Streptopelia decipiens*	African mourning dove, mourning collared dove	LC
5	*Streptopelia semitorquata*	Red-eyed Dove	LC
6	*Turtur chalcospilos*	Emerald-spotted Wood Dove	LC
7	*Scopus umbretta*	Hamerkop	LC
8	*Phoeniculus purpureus*	Green wood-hoopoe	LC
9	*Ploceus capensis*	Cape weaver	LC
10	*Ploceus subaureus*	Golden weaver	LC
11	*Cinnyris manoensis*	Miombo double-collared sunbird	LC
12	*Chalcomitra amethystina*	Amethyst (black) sunbird	LC
13	*Chalcomitra senegalensis*	Scarlet-chested sunbird	LC
14	*Anthreptes longuemarei*	Western violet-backed sunbird	LC
15	*Ploceus bicolor*	Forest weaver	LC
16	*Muscicapa striata*	Spotted flycatcher	LC
17	*Motacilla aguimp*	African pied wagtail	LC
18	*Lybius torquatus*	Black-collard barbet	LC
19	*Pogoniulus chrysoconus*	Yellow-fronted tinkerbird	LC
20	*Dendropicos namaquus*	Bearded woodpecker	LC
21	*Mirafra rufocinnamomea*	Flappet lark	LC
22	*Hirundo rustica*	European swallow	LC
23	*Oriolus larvatus*	Black-headed oriole	LC
24	*Corvus albus*	Pied crow	LC
25	*Turdoides jardineii*	Arrow-marked babbler	LC
26	*Phyllastrephus terrestris*	Terrestrial brownbul	LC
27	*Sylvia borin*	Garden warbler	LC
28	*Cisticola juncidis*	Zitting (fan-tailed) cisticola	LC
29	*Terpsiphone viridis*	African paradise-flycatcher	LC
30	*Lanius collaris*	Common fiscal shrike	LC
31	*Laniarius aethiopicus*	Tropical boubou	LC
32	*Dryoscopus cubla*	Black-backed puffback shrike	LC
33	*Cinnyricinclus leucogaster*	Violet-backed (plum-coloured) starling	LC
34	*Zosterops senegalensis*	African yellow white-eye	LC
35	*Cinnyris venustus*	Variable (yellow-bellied) sunbird	LC
36	*Cinnyris talatala*	White-bellied sunbird	LC
37	*Cinnyris cupreus*	Copper (coppery) sunbird	LC
38	*Ploceus cucullatus*	Village (spotted-backed) weaver	LC
39	*Anaplectes melanotis*	Red-headed weaver	LC
40	*Ploceus velatus*	Masked weaver	LC
41	*Centropus senegalensis*	Senegal coucal	LC
42	*Quelea quelea*	Red-billed quelea	LC
43	*Euplectes orix*	Southern red-bishop	LC

44	*Euplectes afer*	Yellow-crowned (golden) bishop	LC
45	*Euplectes capensis*	Yellow bishop (cape/yellow-rumped widow)	LC
46	*Uraeginthus angolensis*	Blue waxbill	LC
47	*Estrilda astrild*	Common waxbill	LC
48	*Vidua macroura*	Pin-tailed whydah	LC
49	*Urocolius indicus*	Red-faced mousebird	LC
50	*Colius striatus*	Speckled mousebird	LC
51	*Halcyon senegalensis*	Woodland kingfisher	LC
52	*Halcyon albiventris*	Brown-headed kingfisher	LC
53	*Halcyon chelicuti*	Dtriped kingfisher	LC
54	*Pycnonotus tricolor*	Dark-capped (black- eyed) bulbul	LC
55	*Streptopelia capicola*	Cape turtle (ring-necked) dove	LC
56	*Oena capensis*	Namaqua dove	LC
57	*Treron calvus*	African green pigeon	LC
58	*Bubulcus ibis*	Cattle egret	LC
59	*Poicephalus suahelicus*	Grey-headed parrot	LC
60	*Poicephalus meyeri*	Meyer's (brown) parrot	LC
61	*Macrodipteryx vexillarius*	Pennant-winged nightjar	LC
62	*Merops pusillus*	Little bee-eater	LC
63	*Coracias caudatus*	Lilac-breasted roller	LC
64	*Halcyon leucocephala*	Grey-headed kingfisher	LC
65	*Dicrurus adsimilis*	Fork-tailed drongo	LC
66	*Muscicapa adusta*	African dusky flycatcher	LC
67	*Hirundo rustica*	Barn (European) swallow	LC
68	*Sylvietta rufescens*	Long-billed crombec	LC
69	*Camaroptera brevicaudata*	Grey-backed camaroptera	LC
70	*Tauraco schalowi*	Schalow's turaco	LC
71	*Prinia subflava*	Tawny-flanked prinia	LC
72	*Cercropis cucullata*	Greater striped swallow	LC
73	*Emberiza cabanisi*	Cabanis's bunting	LC
74	*Dendropicos griseocephalus*	Olive woodpecker	LC
75	*Dendropicos fuscescens*	Cardinal woodpecker	LC
76	*Gallinula chloropus*	Common moorhen	LC
77	*Amaurornis flavirostra*	Black crake	LC
78	*Milvus aegyptius*	Yellow-billed kite	LC
79	*Pytilia afra*	Orange-winged (Golden-backed) pytilia	LC
80	*Lagonosticta nitidula*	Brown firefinch	LC
81	*Lagonosticta rubricata*	African (Blue-billed) firefinch	LC

All the bird species observed within the Ngolongozya Dam's area of influence are listed as List Concern (LC) under the IUCN Red List.

Amphibians

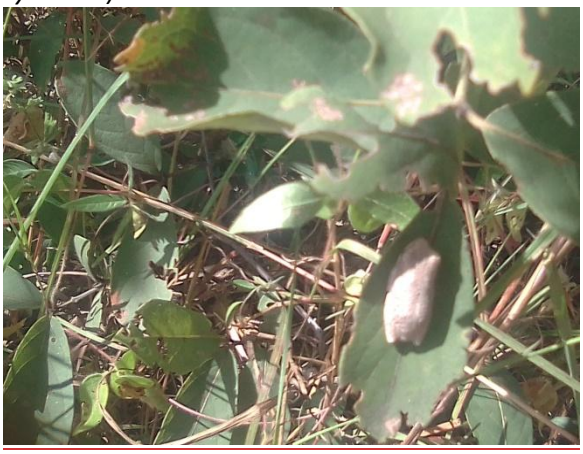
During the Field survey, a total number of 11 amphibian species were recorded. These were all frogs and toads. Some of the amphibians observed on site are shown in Figure 62 while a full list of the

amphibians recorded during the study is presented in Table 34. None of the observed amphibian species is Threatened, Endangered, or Critically Endangered as listed under the IUNC Red List status.

Gray tree frog, Hyla versicolor

Wood frog (*Lithobates sylvaticus or Rana sylvatica)*

Gray tree frog (Hyla versicolor)



Painted reed frog (Hyperolius marmoratus white)

Figure 62 Some Amphibians observed on site during the survey

Table 34 List of amphibians observed on site

No.	Scientific Name	Common Name	IUCN Status
1	*Hyla versicolor*	Gray tree Frog	LC
2	*Lithobates sylvaticus or Rana sylvatica*	Wood frog	LC
3	*Hyperolius marmoratus white*	Painted reed frog	LC
4	*Hyperolius pictus*	Variable reed 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
10	*Sclerophrys pusilla*	Eastern flat-backed toad	LC
11	*Schismaderma carens*	African road toad	LC

Invertebrates

Regarding invertebrates, the study recorded a total number of 28 different species. Of these, the most abundant were Termites, Ants, Butterflies, Grasshoppers and Crickets. Some of the observed invertebrates are shown in Figure 63 while the full list is presented in Table 35.

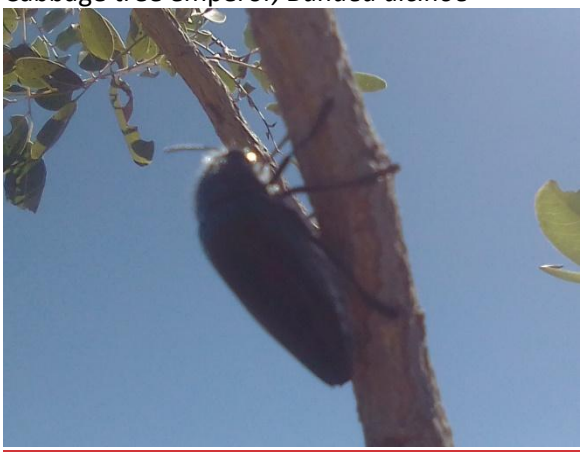
It should be noted that none of the observed invertebrates is listed as Threatened, Endangered, or Critically Endangered under the IUCN Red List.

Further, no invertebrates endemic to the area were observed i.e. all observed invertebrates are widespread within the country and region.

Diplopod, *Julida julida*

Cabbage tree emperor*, Bunaea alcinoe*

Blister beetle, *Meloidae*



Jewel beetle, *Sternocera orissa*

Figure 63 Some Invertebrates observed on site

Table 35 Invertebrates observed on site

No.	Scientific Name	Common Name	IUCN Status
1	*Bunaea alcinoe*	Cabbage tree emperor	LC
2	*Jewel beetle*	Sternocera orissa	LC
3	*Meloidae*	Blister beetles	LC
4	*Danaus chrysippus*	African monarch	LC

5	*Leptotes pirithous*	Common blue	LC
6	*Belenois aurota*	Brown-veined white	LC
7	*Colotis danae*	Scarlet tip	LC
8	*Nephila senegalensis*	Banded legged golden orb-web spider	LC
9	*Family: Ageleni*	Nursery web spider	LC
10	*Pyrota lineata*	Blister beetle	LC
11	*Apis mellifera*	Honey bees	DD
12	*Microtermes goliath*	Termites	DD
13	*Trithemis kirbyi*	Dragon fly	LC
14	*Julida julida*	Diplopod	DD
15	*Trichonephilia clavipes*	Spider	LC
16	*Acraea eponina*	Butterfly	LC
17	*Madateuchus viettei*	Dung beetle	DD
18	*Julus terrestris*	Millipedes	DD
19	*Caelifera*	Grasshopper	DD
20	*Eurema brigitta,*	Butterflies	LC
21	*Carabidea*	Beetles	DD
22	*Dorylus helveolus*	Ants	DD
23	*Belonogastar junceus*	Wasps	DD
24	*Musca domestica*	House lly	DD
25	*Brachytrypas membraneus*	Giant crickets	DD
26	*Halyomorpha halys*	Stink bug	DD
27	*Chinavia hilaris*	Green stink bug	DD
28	*Acanthoplus discoidalis*	Giant cricket	LC

Aquatic Survey Results

Habitats

Damming of the river has resulted in creation of 3 sub-habitats (Table 36):

Table 36 Aquatic habitats

Habitat Type	Sub- Habitats	Characteristics
River	Upstream	Water generally flowing slowly, except at points where gradient was steep. The banks lined with vegetation. Instream, there is emergent vegetation; and an assortment of fauna. In the dry season, water remains in ponds/ dambos (Appendix 5) which form aquatic habitats. These dambos are up to about 2 m deep.
	Reservoir	Open waters or pelagic with very minimum flow, owing to the weir. The edges lined with vegetation. Instream, there is mostly emergent vegetation; and

		assorted fauna.
	Downstream	Very fragmented, isolated pools of water in some places, and narrow stream. The stream is seasonal therefore flows are not notable after the rainy season. Depressions in the riverbed collect water and support life forms. These dambos are up to about 2m deep.

Modifications have taken place upstream, in the reservoir and downstream (table 37 through to table, 42). However, it's in the downstream environments where huge modifications have occurred (table 41 & table 42). This is on account of lack of continuous environmental flows downstream. The downstream environments are usually highly dependent on the sediment dynamic.

The whole system (upstream, reservoir, downstream), has been moderately modified. It has an average ranking of 65.

Table 37 The riparian assessment – upstream

Riparian	Average score	Score
Indigenous vegetation removal	13	6.24
Exotic vegetation encroachment	0	0
Bank erosion	8	4.48
Channel modification	8	3.84
Water abstraction	8	4.16
Inundation	8	3.52
Flow modification	8	3.84
Water quality	3	1.56
Total Riparian	**72.36**	
Category		**(Moderately modified)**

Table 38 The instream assessment - upstream

Instream	Average score	Score
Water abstraction	13	7.28
Flow modification	8	4.16
Bed modification	8	4.16
Channel modification	3	1.56
Water quality	3	1.68
Inundation	3	1.2
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**80**	
Category		**B (Largely natural, few modifications)**

Table 39 The instream assessment - reservoir

Instream	Average score	Score
Water abstraction	3	1.68
Flow modification	23	11.96

Bed modification	0	0
Channel modification	23	11.96
Water quality	3	1.68
Inundation	23	9.2
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**63.52**	
Category		**C (moderately modified)**

Table 40 : The riparian assessment - reservoir

Riparian	Average score	Score
Indigenous vegetation removal	13	6.24
Exotic vegetation encroachment	0	0
Bank erosion	8	4.48
Channel modification	8	3.84
Water abstraction	3	1.56
Inundation	3	1.32
Flow modification	8	3.84
Water quality	3	1.56
Total Riparian	**77.16**	
Category		**A (moderately modified)**

Table 41 The instream assessment - downstream

Instream	Average score	Score
Water abstraction	0	0
Flow modification	25	13
Bed modification	25	13
Channel modification	25	13
Inundation	25	10
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**51**	
Category		**D (largely modified)**

Table 42 The riparian assessment for - downstream

Riparian	Average score	Score
Indigenous vegetation removal	23	11.04
Exotic vegetation encroachment	0	0
Bank erosion	23	12.88
Channel modification	23	11.04
Water abstraction	3	1.56
Inundation	5	2.2
Flow modification	25	12
Total Riparian	**49.28**	

Category	(Largely modified)

Environmental flows:

The stream is in the upper catchment were fish migrations might not be very important. Small dams from seasonal streams only flow during the rainy season. Additionally the MAR/Storage ratio is below 0.25. Consequently, the dam allows flows over the spillway causeway during the runoff season. For environmental flows, where the storages are such that annual spills are limited; when the MAR / storage ratios are greater than approximately 1, then an environmental flow should be considered. However, this is not the case for Ngolongozya Dam. Further to this, if environmental flows are required where the dam has a small functioning outlet and pipes, it may mean that to change the outlets requires that the dam wall be breached down to an acceptable foundation i.e. riverbed and installed. Locating a non-compressible uniform foundation over an existing embankment will be an investigative challenge. Having high releases from the small dam will have very limited effect and further reduce its limited usage. Upstream and downstream of the dam, water collects in the depressions/ dambo structures throughout the year (mapped in Appendix 5). This was the situation even before dam construction and is the case with other seasonal streams around the district. The remedial design will not change this regime but will work on the non-functional outlets and deteriorating causeway.

Water Quality

Good water quality is indicative of a suitable environment as regards sustaining various life forms. 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 43). Laboratory results for pH and conductivity are included in Table 4-18 in brackets. Other laboratory results are shown in Appendix 7. A comparison of the monitoring values with reference ones (table 43), indicates the following:

- Dissolved oxygen for all sampling stations registered values within normal range except downstream where value obtained is slightly on the higher side.
- pH, values obtained across all stations fall within the normal range.
- For temperature, it's only at the weir where a value outside normal range was obtained.
- Conductivity at all the sampling stations except downstream registered values far less than the recommended ones. 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 are often an indicator that a discharge or some other source of pollution has entered the aquatic resource.
- Water transparency was poor at the sampled sites except at the weir and mid of the dam. Such a scenario is not healthy for the ecosystem as regards to primary production (Tanebe et al, 2019).

Table 43 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 degree C**	**6.5-8.5**	**150-500**	**25-60**

Downstream	7.89	28.4	6.81 (6.99)	170.7 (229)	17
At the weir	5.87	32.3	6.21 (5.44)	73.3 (86)	27
Midpoint of the dam	6.88	24.5	6.37 (5.67)	72.9 (82)	26
Point where river enters dam	7.01	25.4	6.11 (4.49)	62.9 (151)	13.5
Upstream	6.93	27.1	6.53 (6.11)	78.6 (87)	20

Results arising from analyzing water samples show small quantities of ammonia, nitrates and phosphates (Appendix 7). Suffice to mention that these are major constituents of fertilizers used in Zambia. Since there is some farming within the vicinity of the dam, this could mean that there is low usage of fertilizers or could be attributed to the high dilution capacity of the dam as at the time of conducting this study. These chemicals if present in huge quantities in a water body are capable of precipitating an algae bloom which could impact negatively on the whole ecosystem.

A total of 17 phytoplanktons and 22 zooplanktons (Appendix 7) were identified in the water samples. Both are critical as regards the food chain in aquatic system. The former acts as energy transducers and converts the solar energy into chemical energy for food. The latter pass this food energy to the higher trophic levels and thus provides a link between energy producers and the consumers. Further, these organisms are important biological indicators of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes.

Fish Survey

Table 44 Fish species captured and their attributes

Family	Species	Total weight in (g) captured	Relative abundance (%)	IUCN status	Migratory species (Yes/No)
Clariidae	*Sharptooth catfish (Clarias gariepinus*	**530**	**11.4**	**LC**	No
Cyrinidae	*Dashtail barb (Barbus poechi)*	**10**	**0.2**	**LC**	No
Cichlidae	*Redbreast tilapia (Coptodon rendalli)*	**635**	**13.7**	**LC**	**No**
	Three spotted tilapia (Oreochromis andersonii)	**610**	**13.1**	**VU**	**No**
	Green headed Tilapia (Oreochromis machrochir)	1435	**31.8**	**VU**	**No**
	Cross (Oreochromis machrochir & Oreochromis andersonii	1385	**29.8**	**N/A**	**N/A**
	TOTAL	4645	**100**		

Six species were captured during experimental fishing at Ngolongozya (table 4-20, fig 4-8) belonging to 3 families namely *cichlidae, clariidae* and *cyprinidae*. Interestingly, also is that a cross between *Oreochromis machrochir & Oreochromis andersonii* was captured. The CpUE was 0.435kg/100m net/hour. During interviews with the dam management committee, it was gathered that *Banded tilapia* (*Tilapia sparmanii*) (LC) and *Bulldog* (*Marcusenius macrolepidotus)* (LC) were present at Ngolongozya. As regards to IUCN conservation status, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Three spotted tilapia *(Oreochromis andersonii)*

Green headed tilapia *(Oreochromis machrochir)*

Coptodon rendalli *(Red breasted tilapia)*

Dashtail barb (Barbus poechii)

Figure 64 Pictures 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. It 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). It lives for up to 11 years (IUCN, 2021). At Ngolongozya, presence of this species was noted in the reservoir and upstream. Upon rehabilitation of the dam, its population is expected to grow in size due to enhanced habitat integrity and absence of threats emanating from *Oreochromis niloticus*. However, an upscale in fishing, which will unfold on account of increased human population around the dam, will be critical as regards to how its population evolves over time. During the runoff season, the fish migrates with the flow over the spillway and over/ under the causeway.

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 Chambeshi 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 *Oreochromis niloticus* and is displaced by it in areas where the two species occur together (IUCN, 2021). At Ngolongozya, this species was present and captured in the reservoir, upstream and downstream. As in the case of *Oreochromis andersonii*, its population will definitely increase on account of improved habitat integrity and absence of threats emanating from *Oreochromis niloticus*. However, a projected increase in fishing, which will accompany increased human population around the dam area, could be critical as regards to how its population performs over time.

Invertebrates

A total of 10 macroinvertebrates were encountered in the field (Table 45). Some of the macroinvertebrates are key by being links in the food web between the producers and higher consumers such as fish.

Table 45 nvertebrates

English name	Scientific name	IUCN status
Dragon flies	*Anisoptera sp.*	DD
Horse fly	*Tabanus bovinus*	DD
Mosquito	*Aedes sp*	DD
Midges	*Chironomus 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	*Gastropod asp*	DD

Aquatic flora

Aquatic flora plays significant roles in an aquatic ecosystem. It provides food, shelter and breeding sites for some fauna (Tsugi & Muzungilwa, 2002). During this survey 5 species of aquatic flora were encountered (table 46). As regards IUCN conservation status, the entire flora is of least concern. This included an aquatic smart weed.

Table 46 Aquatic flora

English name	Botanical name	IUCN STATUS
Bullrush	*Typha angustifolia*	LC
Filamentous algea	*Pleurastrum terricola*	LC
Cattail	*Typha latifolia*	LC
Giant Reeds	*Phragmites sp.*	LC
Smartweed	*Polygonum pensylvanicum*	LC

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 47. 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 47 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
TERRESTRIAL											
Site Preparation and Construction Phase											
Impacts on Terrestrial Habitats											
Reduced integrity and/or destruction of habitats on site	Fragmentation and depletion of habitats	Sub-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	Medium	Medium
	Reduced value or integrity of habitats	Mismanagement of sub-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,	Rare	Likely	Local	Medium	Low	Negative	Direct/Ind	Mediu	Medium

		hydrocarbons and different streams of waste can further reduce the value of habitats on site							ir ec t	m	
	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.	Ra re	Unl ikel y	Lo ca l	M ed iu m	Lo w	Ne gat ive	In di re ct	M e d i u m	Lo w
Impacts on Terrestrial Biodiversity											
Vegetation loss-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	Ra re	Cer tai n	Lo ca l	Lo ng	M ed iu m	Ne gat ive	Di re ct	M e d i u m	M edi u m
	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	Ra re	Lik ely	Lo ca l	Lo ng	Lo w	Ne gat ive	In di re ct	M e d i u m	Lo w
	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	Ra re	Cer tai n	Lo ca l	Lo ng	Lo w	Ne gat ive	Di re ct	M e d u i m	M edi u m

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
Increase in vehicle-fauna collisions	Injury or mortality of fauna	Increased vehicular movement in the project area of influence may potentially result in collisions with fauna on site that is not accustomed to this situation. In case of occurrence, this can result in injury or mortality.	Rare	Unlikely	Local	Medium	Low	Negative	Direct	Low	Low
Fauna loss-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	Medium	Low	Negative	Indirect	Low	Low
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	Medium	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	Medium	Low	Negative	Indirect	Low	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; 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
	Injury or mortality of fauna		Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low
Operations Phase											
Water Availability											
Increased water availability in the dam- Water harvesting or storage in dam	Increased availability of water	Remedial works will increase the efficiency and capacity of the dam to hold water. This will make more water available for flora and fauna all year round. Stored water will also contribute to the charging of ground water system	Frequent	Certain	Local	Long	High	Positive	Direct	Medium	High
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 Ngolongozya 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
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
Increased risks of 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	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low
Increased risk of water pollution by hazardous waste	Loss of flora and fauna, degraded habitats	Some by- products of construction work, could be hazardous. And if they are disposed in water, unintentionally or 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

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. The dam provides enough water all year round and an environment for species of conservation concern to thrive. The water body has more life forms than the dambos or streams	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Habitat pressure caused by the dam	Increased fishing, irrigation and livestock causing 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. This can lead to 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
Enhancement of environmental flows	The downstream flows will continue during the runoff season in relation to the design	The flows will be maintained as per the design and storage ratios. These might increase as the spillway will be improved. 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 will be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Medium	Medium	Positive	Direct	Medium	Medium
Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam will ensure increased habitat integrity and populations of aquatic biodiversity.	Frequent	Certain	Local	Medium	High	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
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
Increase in water pollution	Chemicals used for agriculture and loose soils from fields may run into the waters	Increased chemical pollution from irrigation 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	Certain	local	Medium	Medium	Negative	Indirect	Medium	Medium
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
- Possible deterioration of water quality downstream due to biocides that may be used during irrigation agriculture
- 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 and fauna when habitat integrity is enhanced
- Maintained environmental flows downstream and protected upstream, downstream dambos, and the dam habitats - the downstream flows will 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
- Possible deterioration of water quality downstream, upstream and in the dam due to biocides that may be used for irrigation agriculture and soil erosion due to farming methods
- 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.

Concluding Impact Statement

Ngolongozya Dam provides a permanent water body on the Ngolongozya River, which is a seasonal tributary of the Kalomo River in the Zambezi River system. Situated towards the upper end of the catchment, the dam spills regularly in the rainy 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. 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 the practice of farming in the dambos and general habitat degradation in the surrounding areas and not attributed to the dam's impoundment.

Since the dam was first built nearly 4 years ago it is likely that the remedial works will encourage additional cultivation through the introduction of irrigation but 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 dam committee, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources will 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)

In an effort to enhance the management of biodiversity in the project area of influence, a site-specific Biodiversity Management Plan (BMP) has been developed in this section and Appendix 8 –Habitat Management. The BMP 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.

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 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 Ngolongozya 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 48 Biodiversity Management Plan (BMP)

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
1.0. SITE PREPARATION AND CONSTRUCTION PHASE						
1.1. TERRESTRIAL						
Indigenous Flora						
1.1.1	Loss of indigenous flora species/Reduction in population	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor will 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 will not be disturbed (Appendix 8- dam and dambo management). Flora management will be included in the sites' method statements (refer to ESMP).	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will 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 will not be close to riparian buffer zones/ water bodies (Appendix 8- dam and dambo management).	Mobilization	End of construction works	Contractor Supervision- UNOPS
			Whenever possible e.g. at campsites, the contractor will 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 will not use indigenous timber/wood for construction and related works on site as this will not be allowed. When	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS

			timber is required, it will be procured from licensed pine and/or eucalyptus dealers.			
			The contractor will 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
1.1.2	Increased habitat loss by the introduction of Invasive flora species	Avoid and/or prevent the introduction of invasive species	The contractor will 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 contractor will 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 for Project vehicles that are suspected to have been in areas infested with invasive species.	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS
			The contractor will ensure that only non-invasive local plant species are used for revegetation efforts under the sub-project.	Beginning of construction works	Project closure	Contractor Supervision- UNOPS
		To control the spread of *Lantana camara* and *Helianthus tuberosus* on site	UNOPS with Forestry will train and assist the DMC implement a programme for uprooting *Lantana camara* and *Helianthus tuberosus* which have infested the project area of influence.	Beginning of construction works	Project operation	UNOPS and DMC
Fauna						
1.1.3	Injury and/or	To preserve fauna in	The contractor will not allow or	Beginning of	Project	Contractor, ZAWA,

	loss of fauna	and around the project site	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 will be included in the sites' method statements (refer to ESMP).	construction works	Closure	Traditional Authorities and DMC Supervision - UNOPS
			The contractor will avoid clearing/cutting down of *Acacia* trees in riparian habitats and on the edges of dambos for any purpose. This is because Acacia trees in the riparian habitats are mainly used for nesting by indigenous.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will ensure that active bird nests are not damaged during site preparation and construction activities. As far as 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 ecologist.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.4	Increased injury or mortality of fauna due to accidents	Avoid collisions of vehicles with fauna on site	The contractor will ● Provide driver awareness and training; ● Enforce speed limits;	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

			● 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			
1.1.5	Increased disturbance or disruption of fauna activities due to construction works	To avoid disturbance of nocturnal fauna on site	The contractor will 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 migration or night movement of certain species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			When there is need to use lighting at night, the contractor will 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 will: ● Service all equipment and vehicles in line with manufacturers specifications; ● Not allow idling of vehicles	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

			on site and unnecessary honking; ● Sensitize employees on the need to minimize noise on site			
1.1.6	Loss of species due to the introduction of invasive fauna species into the project area of influence	To avoid the introduction alien fauna species	The contractor will: ● Develop Project staff conduct guidelines that would include the interdiction of transporting live or dead animals, plants or seeds in Project related 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
Habitats						
1.1.7	Increased habitat fragmentation	Avoid further fragmentation of habitats	The contractor will 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 sub-project	The contractor will not carry out any construction and related project activities within dambos and fruit forests on site. Coordinates for these areas are given in Table 4-1 and Table 4-2.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will 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.	Beginning of construction works	Project Closure	UNOPS and DMC
			The DMC and UNOPS will ensure that	Project	On-going	Traditional Authority

			there are no agricultural activities within identified dambos, fruit forests and along the riverine.	mobilization		and DMC
1.1.8	Loss of integrity of the terrestrial habitats	To preserve the integrity of the vegetation on site	The contractor will 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 construction works	Contractor Supervision - UNOPS
			To minimise risk of pollution, the contractor will: ● Store all hydrocarbons including fuels, used oils, new and used oil filters and grease in designated places fitted with spillage protection mechanisms such as bunding and impermeable flooring ● Train employees handling these materials in material handling and spill prevention	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
1.1.9	Increase in fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor will not allow bush burning and or open fires in forested or vegetated areas. Employees will be sensitised to this effect.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			The contractor will 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						

1.1.10	Increased capacity building activities by training	To capacity build the contractor's employees in BMP implementation	The contractor will 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 will 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 ● Sustainable management of the water dam on site ● Identification and Handling of key invasive species such as *Lantana camara* and *Helianthus tuberosus* ● Roles of community members on biodiversity management	Project mobilization	Project closure	UNOPS
1.2. AQUATIC						
1.2.1	Increase in pollution and siltation of water	To ensure that pollution, soil loosening and siltation is controlled	The contractor will carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste will be disposed of in a matter prescribed by ZEMA and the local town council.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

			The contractor will maintain buffer zones (Appendix 8- dam/ dambo management).			
1.2.2	Increased demand for water Increased demand for water could compromise aquatic habitats	To ensure prudent usage of water throughout construction phase and thereafter	The contractor will ensure that construction water will not compromise aquatic biodiversity requirements and environment.	Project Mobilization	On-going	● Contractor ● Supervision UNOPS ● DMC ● Traditional leaders ● Department of water Affairs
1.2.3	Increased 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 will adhere to best practices recommended by ZEMA when handling such materials. The waste will be kept in bunded facilities. The final handlers will be licensed waste management handler. Hydrocarbons will not be allowed in water. Any spill will be handled using spill kits and isolation methods. These will be disposed of in a matter prescribed by ZEMA.	Project mobilization	End of construction works	Contractor 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	Dam Management Committee 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	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS

		(Appendix 8)	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 will implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.			
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						
2.1.3	Sites restoration by the rehabilitation of	To rehabilitate both New and Old Borrow Pits on site	At the end of construction works (during operation phase of the dam), the contractor will rehabilitate both	Operations Phase of the project	Completion of rehabilitatio	Contractor and UNOPS

	legacy and present borrow sites		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.		n works	Supervision - UNOPS
Training (Capacity Building)						
2.1.4	Increase in capacity building activities among DMC and local community members	To train or sensitize DMC and local communities	anding over of the dam, UNOPS will 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.	Operation Phase	ion of training	
Species						
2.1.5	Increase in invasive fauna and flora species management	To Prevent colonization of project area of influence by invasive species	will train the DMC and selected local community members on the implementation of invasive species management.	Operation Phase	ion of training	
Demobilization						
2.1.6	Increase in site disturbances and aesthetics effects	To leave the site in the initial or better state relative to the baseline	end of construction works, the contractor will remove all equipment and structures from construction camp site;	construction works	ization	or ion - UNOPS

			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			
			nd of remedial construction works, the contractor will rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP.	construction works	ization	or ion - UNOPS
AQUATIC						
2.2.8	Increased potential growth of algae in the dam and dambos/ wetlands upstream or downstream due to agriculture/ irrigation (use of biocides) and from livestock droppings	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during agriculture activities	The IDSP/ Ministry of Agriculture will 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
2.2.9	Overexploitation of fish resources which reduce fish population Loss of species of conservation concern due to	To ensure that fish resources are sustainably utilized	The Dam Management Committee (DMC) and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with respect to who can fish, where, when and how. The dam should not be open access with respect to fishing.	End of construction works	On-going	DMC Ministry of fisheries & Livestock Traditional leaders

	overfishing and introduction of invasive species		The DMC and traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of the threated tilapia species. Controlled catching and breeding season breaks will be enforced by the DMC and Fisheries. Fishing methods will be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity will be protected by sedimentation control and pollution prevention by the communities; and by catchment management. The DMC and Fisheries will not further introduce invasive species such as the *O.niloticus* in the water.			
2.2.10	Increased education and awareness on threatened tilapia species Capacity building- Increased knowledge and	To create awareness and educate the communities concerning the 2 threatened *tilapia* species (Green headed bream (*Oreochromis machrochir* and Three spotted tilapia	The DMC collaborating with the Dam Management Committee and traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of the threated tilapia species. Catch and release recommended for these species.	Project mobilization	On-going	Supervision DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders

	ability among locals	(*Oreochromis andersonii*) to ensure sustainability	Further, the DMC working hand in hand with Traditional leaders, Ministry of Fisheries and Livestock, UNOPS will train locals, employees on matters such as dam management, biodiversity conservation and implementation of the BMP.			
2.2.11	Maintained and promoted environmental flows downstream	To ensure downstream flows during rainy season	The UNOPS design team will ensure that ecological flows over the spillway are continuous during the rainy season according to the dam's storage ratio. The IDSP and UNOPS will train the DMC on flow monitoring and its importance. The DMC and IDSP will monitor the flows during the runoff season. The dambos will be protected by the communities to maintain the habitats throughout the year. DMC will protect these habitats to ensure continuous protection of life forms and their flow during runoff seasons. DMC will ensure protection and maintenance of. The dambos and dam will be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion.	Operation phase	On-going	Communities, DMC

2.2.12	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, will 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
2.2.13	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
2.2.14	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure,	To ensure that sedimentation is controlled To ensure dam functionality To promote maintenance activities post rehabilitation works	The contractor will 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	Project mobilization	On-going	DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders Water resources development department

	settlements/infrastructure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives		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 will also implement catchment management 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: determine 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 49 Biodiversity Monitoring Table

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 will use already cleared areas where possible. Where there is need to clear, clear boundary or working area will be defined and fenced off as the only defined area where vegetation clearing will take place.	During remedial works	● Contractor ● UNOPS	Vegetation maintained in the present condition except for defined areas as demanded by project works/accessories.
			The contractor in consultation with FD personnel will 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	The contractor will conduct a re-forestation program in areas	At completion of remedial works.	● Contractor ● Forestry	Degraded sites artificially aided to

		various forms of insects and animals.	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.		Department ● Dam management committee	regenerate by onset of rain following completion of works.
3	Increase in soil degradation	To restore soil organic matter and soil micro-organisms lost due to trampling and compaction by equipment and machinery during remedial measures.	The contractor will 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.
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 will 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 reports indicating how much was used.
5.	Increase in habitat integrity-Rehabilitation of legacy and current sites	To ensure that all impacted sites are brought back to their near original state.	The contractor 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.	Increase in skills, training / Capacity building	To ensure compliance to various environmental parameters and knowledge of dam operations and maintenance	UNOPS will develop a dam operation manual and selected relevant sections to capacity build in the DMC. The contractor with stakeholders will provide trainings to the DMC and community. Guided	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

			by the supervising engineer, selected topics will be covered to sensitize the local community.			
Operation phase						
1.	Loss of ecosystem services provisioning	To restore the inherent ability of the miombo woodlands to provide ecosystem services such as NWFP*, ethnobotanic value etc.	The DMC and Forestry will conduct reforestation of the impacted areas. It will: ● 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	During and after rehabilitation works. Monthly visits in the initial stages then quarterly after the reforested areas establish and when community structures become fully functional.	● DMC ● Local traditional leadership ● Ministry of Agriculture ● Forestry ● Catchment committee	Reforestation of cleared areas done at the onset of the rain season following 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.

			based natural resource management ● Catchment management ● Control and monitor 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 will protect the Ngolongozya 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. ● Dam committee	Catchment area protection sensitization programme.
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds in the habitats	Loss of feeding and breeding grounds	The contractor will maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	● Contractor ● UNOPS ● DMC ● Fisheries	Protected breeding grounds
2.	Increase in aquatic weeds	To limit weeds around the weir and spillway area	The contractor will ensure that these are properly removed during works to avoid further migrations and dispersion. The methodology will be approved by the engineer.	During rehabilitation works	● Contractor ● UNOPS ● IDSP	Methodology and well removed and destroyed weeds
3	Increase in soil erosion from disturbed areas causing siltation in the reservoir and parts of upstream and downstream	To arrest soil erosion from taking place, which smothers sediments that provide food nutrients for aquatic species.	The contractor will ensure the disturbed areas and open slopes are revegetated to arrest occurrence of soil erosion	During rehabilitation works	● Contractor ● UNOPS ● IDSP	No sites in the surrounding environment are opened up to soil erosion.

5.	Increase in fish abundance in the dam due to favorable breeding and feeding grounds	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries will regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	● Fisheries department ● DMC ● Local traditional leadership	Dam management by-laws drafted by completion of rehabilitation works
6.	Increased impacts on the species of conservation concern	To avoid any mortalities of these species	The contractor will conduct robust visual observations before undertaking any works The DMC and fisheries will 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 will protect the breeding grounds for fish by ensuring no fishing activities take place in willow waters. DMC and Fisheries will protect vulnerable fish species by monitoring the quantities and using safe fishing methods DMC will monitor and control invasive weeds	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 will maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders will conduct catchment management (Appendix 8)	During and after rehabilitation works.	● Department of Forestry ● Fisheries Department ● Local traditional leadership ● DMC	Dam management by-laws drafted by completion of rehabilitation works.

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 will 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 dam committees 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.
4.	Increase in aquatic exotic weeds	To maintain the quality of water in the dam for improved aquatic biodiversity.	DMC will remove the dense floating grassy mat that is engulfing the dam upstream near the weir and any in other areas it sprouts up during the operation of the dam.	During and after rehabilitation works.	● DMC ● IDSP	The floating weed not present in the limnetic zone of the dam during operation.

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 50 Roles 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 Ngolongozya 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 Ngolongozya dam. The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Ngolongozya 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 Ngolongozya Dam. The IDSP will have an environmental specialist who will 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 Ngolongozya dam for 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, dam committee 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 dam committee. IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Ngolongozya 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.
UNOPS/ Supervising Engineer	The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Ngolongozya 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 will 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 will 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 will 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 Ngolongozya 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 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 mitigation measures laid out in this BMP, as well as all trainings and other required activities. UNOPS will 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 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.
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 will inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.
Contractor	UNOPS will contract the contractor after preparation of bidding documents. 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 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 will 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 will 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 stockpiling Sanitation and water management Traffic management and access routes management Biodiversity management 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. The contractor must report on all HSSE matters related to this BMP 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 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 Dam Committee 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 dam committee 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 the DMC, which consists of community members. The Ngolongozya 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 Ngolongozya DMC. In order to successfully operate the dam, and limit impacts on people and environment, the dam committee 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 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 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 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 training are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Ngolongozya DMC who is part of the local community and local authorities. IDSP will continually engage with the communities and local authorities throughout the lifespan of the dam.

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Appendix 1: Sample Plots Coordinates

COORDINATES FOR SAMPLING POINTS		
Sample Plot Number	**Coordinates**	
1.	S 17.36932 ˚	E 026.54183 ˚
2.	S 17.36781 ˚	E 026.54381 ˚
3.	S 17.36627 ˚	E 026.54522 ˚
4.	S 16.73535˚	E 027.361911˚
5.	S 17.36720˚	E 026.54904˚
6.	S 17.37028˚	E 026.74864˚
7.	S 17.36628 ˚	E 026.54027 ˚
8.	S 17.36148 ˚	E 026.54272 ˚
9.	S 17.35916 ˚	E 026.551490 ˚
10.	S 17.35857 ˚	E 026.55449 ˚
11.	S 17.35498 ˚	E 026.55773 ˚
12.	S 17.35022 ˚	E 026.54998 ˚
13.	S 17.355338 ˚	E 026.54423 ˚
14.	S 17.36909 ˚	E 026.53878 ˚
15.	S 17.37168 ˚	E 026.53550 ˚
16	S 17.37849 ˚	E 026.53321 ˚
17	S 17.38163 ˚	E 026.53699 ˚
18	S 17.37865 ˚	E 026.53929 ˚
19	S 17.37353 ˚	E 026.53973 ˚
20	S 17.35882 ˚	E26.55153 ˚

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	CROWN SIZE 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 uncerta + / - -- Identification not sure; ?? – Plant not identified
(Write GENUS name and ?) (Write SUSPECTED NAME an (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

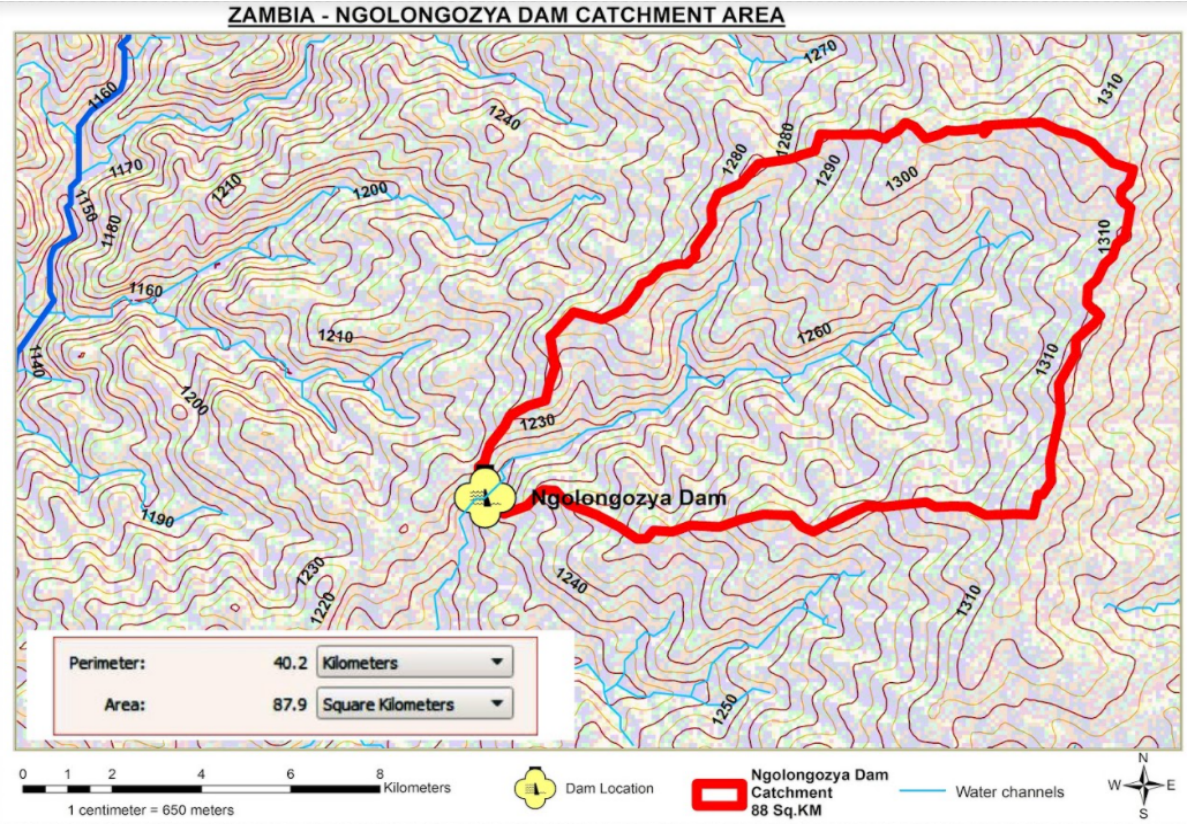
☐ Recent

☐ Old

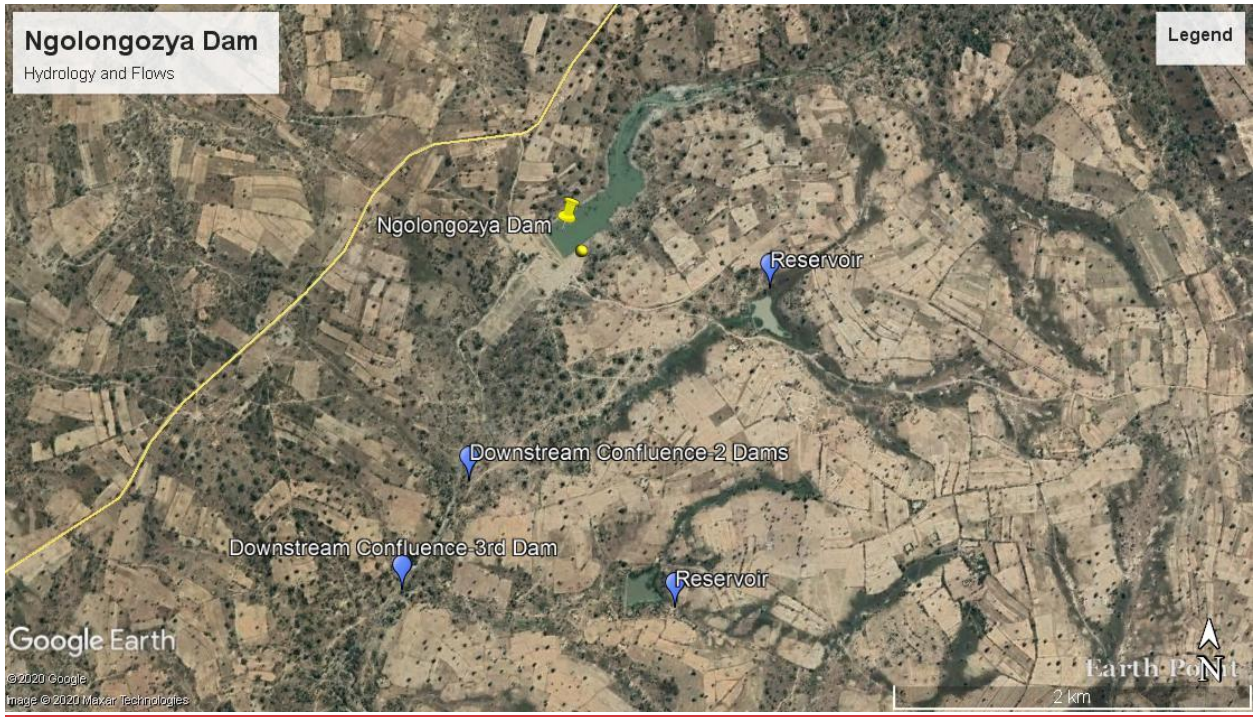
Notes

Appendix 5: Coordinates for Dambos of Interest in the Area

Dambo No.	Elevation (m)	Coordinates	
		South	East
Dambo 1	1213	S 17.35962^0	E 026.54512^0
Dambo 2	1212	S 17.35253^0	E 026.55271^0




Ngolongozya
Dambos and other reservoirs
Legend
Dam
Dambo
Dam 3
Dambo 2
Dambo 1
Dam 4
Dam 2
Ngolongozya Dam
Dam 1
Google Earth
©2021 Google
Image © 2021 Maxar Technologies
4 km
N


Ngolongozya Dam
Hydrology and Flows
Legend
Ngolongozya Dam
Reservoir
Downstream Confluence 2 Dams
Downstream Confluence 3rd Dam
Reservoir
Google Earth
© 2020 Google
Image © 2020 Maxar Technologies
Earth Point
N
2 km

Appendix 6: Data Collection Sheet

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			

D. 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 7 – Water Analysis Results for Water Samples Collected at Ngolongozya Dam.

	Ngolongozya Down Stream	Ngolongozya Entry	Ngolongozya Up Stream	Ngolongozya Dam wall Weir	Ngolongozya Mid
Parameter					
pH	6.99	4.49	6.11	5.44	5.67
Conductivity (µs/cm)	229	151	87	86	82
Sulphates (mg/l)	4.40	23.50	25.60	8.90	14.90
Nitrates (as NO_3 –N mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	130	128	132	54	68
Total Dissolved Solids (mg/l)	113	154	44	43	41
Ammonia (as NH_4-Nmg/l)	0.40	0.50	0.90	<0.01	<0.01
Phosphates (mg/l)	<0.01	0.20	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	92.4	394.0	50.2	20.8	32.4
Chemical oxygen demand (as mg O_2/l)	6	8	4	9	7
Chlorides (mg/l)	10.0	10.0	10.0	10.0	10.0
Turbidity (NTU)	71.80	321.00	102.00	72.40	76.40
Hydrocarbons (mg/l)	<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".

Plankton composition at Ngolongozya Sam

No.	Phytoplankton	Zooplankton
1	*Urothrix*	*Brachionus falcatus*
2	*Anabaena*	*Brachionus caudatus*
3	*Sphacroplea annulina*	*Brachionus angularis*
4	*Phacus triqueter*	*Brachionus calyciflorus*
5	*Trachelomonas*	*Brachionus budapestinensis*
6	*Volvocina*	*Kerratella valga*
7	*Navicula* sp.	*Anuraeopsis fissa*
8	*Pediastrum* sp.	*Hexarthra mira*
9	*Synedra*	*Collotheca ornata*
10	*Microcystis novacekii*	*Colurella obtusa*
11	*Euglena* sp.	*Cyclops*

12	*Microcystis* sp.	*Diurella stylata*
13	*Distigma* sp.	*Diaphanosoma brachyurum*
14	*Closterium*	*Trichocerca cylindrical*
15	*Sorastrum* sp.	*Nauplius*
16	*Tetraedriella laevis*	*Asplanchna herricki*
17	*Micraseris radiosa*	*Simocephalus vetuloides*
18		*Cydorus sphaericus*
19		*Ceridaphania cornuta*
20		*Macrothrix spinosa*
21		*Cydorus shaericus*
22		*Moina micrura*
23		*Daphmidae sp.*
24		*Asplanchona sp*

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[31]. 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 Ngolongozya 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

[31] 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 Ngolongozya 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 will 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 will 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 will be a buffer between the busy roads and the water bodies.
- Maintaining some grass at the water inlets 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.