Environmental and Social Impact Assessment Report for the Kariba Dam Rehabilitation Project (Zambia and Zimbabwe) on the Zambezi River

Zambezi River Authority

January 2016

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January 2016

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EXECUTIVE SUMMARY

The Kariba Dam is a double curvature concrete arch dam located in the Kariba Gorge of the Zambezi River Basin between Zambia and Zimbabwe. The arch dam was constructed between 1956 and 1959 and supplies water to two underground hydropower plants located on the north bank in Zambia and on the south bank in Zimbabwe. Water is released from the reservoir through six sluice gates. In the first 20 years after the dam was constructed there were sustained heavy spillage episodes resulting in erosion of the bedrock to 80 m below the normal water level. This situation could lead to the increased risk of dam failure due to the stability of the dam being undermined. Moreover, the six sluice gates that make up the spillway have been distorted over the years due to an advanced alkali-silica reaction in the concrete. This situation presents sluice gate operational challenges with regards to their use in flood control operations at Kariba.

The Kariba Dam Rehabilitation Project (KDRP) involves reshaping works to the plunge pool (anticipated to take 4 years to complete – i.e. 2015 to 2018) and rehabilitation of the six sluice gates (anticipated to take 8 years to complete – i.e. 2015 to 2022). The details of which include –

Plunge Pool Reshaping Works

The reshaping of the plunge pool aims to address downstream erosion that could undermine the stability of the dam. Planned works will be in the form of an excavation and reshaping of the plunge pool.

The primary aim of these reshaping activities is to improve the stability of the plunge pool, by limiting preferential erosion towards the foundations of the dam, along zones of weak rock. In order to arrive at the solutions described below the engineering team undertook; Multi-beam Bathymetric Survey of the Pool; Plunge Pool Geotechnical Investigations; and Plunge Pool Hydraulic Modeling.

Generally, the reshaping of the plunge pool will include the following activities:

- The construction of a cofferdam just downstream of the plunge pool, which will block off the plunge pool from the downstream river.
- The pumping/dewatering of the plunge pool.
- The excavation of the plunge pool.
- The deposition of excavated rock material in the existing quarry on the north bank.
- The reshaping of the excavated plunge pool into terraced steps.

Spillway Rehabilitation

The main works associated with spillway refurbishment includes the assemblage and transport of a floating cofferdam that will be used for the dewatering of the sluice gates prior to the commencement of rehabilitation. The following activities will be required for the spillway rehabilitation:

- Installation of a floating cofferdam and rehabilitation of sluices gates 1, 3, 4, 5 and 6;
- Upgrading of a slipway for assembly of floating cofferdam;
- Rehabilitation of sluice gate 2;
- Installation of a new emergency gate and gantry.

Reshaping and stabilization of the Kariba Dam Plunge Pool and rehabilitation of the spillway is estimated to cost US$ 80 million and US$ 140 million respectively. Both rehabilitation activities will commence in 2015 and are expected to be completed in 2018 and 2022 respectively.

The Zambezi River Authority (ZRA), a corporation jointly and equally owned by the governments of the Republics of Zambia and Zimbabwe, is the project proponent for the proposed Kariba Dam Rehabilitation Works. ZRA was formed through the Zambezi River Authority Act of 1987 (Act No. 17 and 19 Zambia and Zimbabwe respectively) and is governed by a Council of Ministers (COM). The COM consists of four Ministers, two from each of the contracting states; holding portfolios of Energy and Finance in the respective countries. The functions of ZRA (amongst many others) include operating, monitoring and maintaining the Kariba Complex ("Kariba Complex means: the Kariba Dam and reservoir, all telemetering stations relating to the Kariba Dam, any other installations owned by the Authority").

The ZRA have initiated the Kariba Dam Rehabilitation Project, which is required to reshape the plunge pool and refurbish the spill way to allow for long term safety and reliability of the dam. If the project is not implemented the risk of failure would increase and where dam failure occurs this would result in a major loss of life (approximately three million people). In addition to human fatality risks, dam failure would result in significant downstream environmental damage and a loss of a main source of power to the SADC region. Therefore, timely rehabilitation is required in order to prevent further degradation of dam safety features.

In light of the above, the Zambezi River Authority (ZRA) proposes to improve the stability of the plunge pool through reshaping its profile. This will limit the preferential erosion towards the foundations of the dam wall along zones of weak rock and allow for the safe operation of the dam and continued generation of electricity from the hydropower plants. The second objective of the project is to rehabilitate the six sluice gates of the spillway, enabling the ongoing use of the spillway function to safely manage the reservoir levels.

As part of the proposed rehabilitation Project, the ZRA have committed to comply with both local (Zambia and Zimbabwe) and international (World Bank and African Development Bank) guidelines and standards, and as such are required to undertake a full Environmental and Social Impact Assessment (ESIA) for the Project.

In accordance with the Zambian and Zimbabwean Environmental Management Acts, there is a legal requirement for the Project proponent to respectively submit an Environmental Scoping Report and an Environmental Prospectus report as part of the overall ESIA process. As per the agreed outcomes in a meeting held with the Zambian and Zimbabwean Environmental Management Authorities (dated 24 November 2014, held at the ZRA Administrative Block in Kariba), in which the implementation of a harmonised ESIA process was discussed, a joint Scoping/Prospectus Report was submitted to both Environmental Authorities for review. This Scoping/Prospectus Report fulfilled the Zambian requirements for a Scoping Report and Zimbabwean requirements for a Prospectus report, and has since been approved by the Zambian Environmental Management Agency (ZEMA) on 27 February 2015 (reference number: ZEMA/INS/101/04/1) and the Zimbabwean Environmental Management Agency (EMA) on 02 March 2015 (reference number: 17/1/1/3A).

During the Scoping Phase, communication with stakeholders (including consultation materials) were undertaken in three languages, namely English, Shona (Zimbabwe), and Tonga (and sometimes in Bemba or Nyanja) in Zambia. During this phase, Background Information Documents (BIDs) were distributed, public meetings were held and a number of *ad hoc* face-to-face meetings and focus group discussions were undertaken. Moreover, various site notices were posted in public places in Zambia and Zimbabwe.

Stakeholder consultations during the scoping phase were focused on achieving the following outcomes:

- To meet key stakeholders and introduce them to the Project and ESIA process;
- To identify the issues, needs and expectations of the interested and affected stakeholders;
- To provide opportunity for stakeholders to contribute to the debate with their local knowledge and experience;
- To refine the terms of reference of specialist work on the basis of stakeholder comment received;
- To gather issues of concern and through this identify a list of potential impacts;
- To gather primary data informing the social impact assessment;

- To verify that stakeholders' issues and concerns have been captured; and

- To assist ZRA in strengthening its relationships with existing and future stakeholders.

The ESIA study is the second and final phase of the overall ESIA process being undertaken in support of the proposed Project, and forms the basis on which the environmental license/approval is issued. The purpose of the ESIA process is to:

- Present a detailed baseline review of the physical, biophysical and socio-economic characteristics of the Project Area of Influence and surrounds;

- Assess the impacts (including cumulative impacts) of the physical, biophysical and socio-economic environments related with the different phases of the proposed Project; and

- Provide mitigation measures and an associated environmental and social management plan that aims to avoid /minimise/manage the severity of identified impacts.

The ESIA process undertaken has identified and assessed a range of potential environmental and social impacts associated with the proposed Kariba Dam Rehabilitation Project. Provided that the social and environmental mitigation/management measures provided in this ESIA are implemented, the majority of the impacts identified will be reduced to a minor to negligible level of significance.

The findings of the ***major*** negative environmental and social impacts and ***positive*** impacts together with mitigation recommendations are presented in *Table 1* below:

Table 1 Summary Environmental and Social Impacts

ENVIRONMENT	IMPACT	ASSESSMENT	MITIGATION OR RECOMMENDATIONS	RESIDUAL IMPACT
Physical Environment	**Impacts on Hydrology:** Possible loss of downstream flows due to the possible spilling / non-spilling requirements is likely pose a risk to the maintenance of ecological flow requirements.	**MAJOR NEGATIVE**	• Ensure that the downstream flows are maintained and in the event of a required reduction in water released from the power stations; the Project Developer should ensure that the downstream flows are not less than the maintenance low flow of 440m³/s. • Non-perennial systems (seasonal rivers / streams) affected by linear infrastructure should be crossed perpendicular to banks and where feasible at the narrowest section of the watercourse. • The orientation and placement of in-channel support structures should be perpendicular (at right angles) to the channel (waterway) banks. Where in-channel supports are used, they should be parallel to stream flow. Span bridges should be placed parallel to banks. • Temporary and permanent crossing structures should allow sufficient space to accommodate flood events. • Watercourse crossing design for linear infrastructure, in particular relating to the upgrade of the access road to the quarry, which crosses a perennial stream should aim to maintain natural channel processes. Spanning systems (particularly smaller watercourses) is preferred over in-channel support structures. An ecological sound water crossing allows hydrological and substrate continuity.	**NEGLIGIBLE**
	Creation of employment opportunities: Increased employment creation in the project area as a result of the project's workforce needs for the construction activities over a medium-term (13 years for both the construction of activities associated with the plunge pool and spillway).	**POSITVE**	• The Project Developer, Consulting Engineer and the Contractor will develop and implement Project specific Recruitment Policies. • The Project Developer will set targets to maximise the number of Zambian and Zimbabwean nationals, locals, female, disabled, unskilled, skilled and highly skilled employed by the Project • The Project Developer will set local procurement targets as part of Conditions of Contract with the Consulting Engineer and Contractor. • The Consulting Engineer and Contractor will prepare and submit monthly and cumulative employment statistics reports to the Project Developer. • Annual employment statistics audits will be conducted. Based on the results of the audit, incentive for achieving employment targets can be considered. • All employment opportunities will be public advertised in all newspapers, public libraries, the District Offices and in all relevant languages. • The Contractor will be expected to establish a Recruitment Office with the purpose of keeping a record of available prospective employees, their skills levels and contact details. Registration of job seekers with the Recruitment Office will be free of charge.	**POSITVE**
	Procurement of goods and services: Local, regional and national (small, medium, and large enterprises) will get the opportunity to become part of the project's supply chain.	**POSITVE**	• The Project Developer, the Consulting Engineer and the Contractor should develop and implement their own Procurement Strategies. These strategies will be designed to encourage Project authorities and their design and construction consultants to stimulate in-country business opportunities at local, regional and national level through incentivising in-country procurement. • To the greatest extent possible, mentioned Procurement Strategies will provide for: • The establishment of a service provider database by the Contractor (also for use by the Engineer and Project Developer). The database should reflect the name, type, location, contact details and capacity of the businesses as a minimum. • The unbundling of contracts into smaller and more manageable packages so that in-country and possibly less experienced local and regional suppliers have a better chance of being selected. • Setting procurement targets for different business categories e.g. per sector or in terms in-country or women ownership and or management of the business. • Tracking of performance against procurement targets and issuing of quarterly performance reports to the Project Proponent. • Basic capacity building support to in-country businesses to assist them with responding to tender opportunities and meeting administrative requirements of written communication, invoicing and reporting. • Advertising of procurement opportunities according to a specific, agreed and well–communicated method and medium.	**POSITVE**
	Increased incidence of sexually transmitted infections (STIs) including HIV/AIDS: Transport drivers, who may typically have higher rates of HIV or STIs than the general population, may engage in casual sexual activity at their end destination, acting as a vector for the disease.	**MAJOR NEGATIVE**	• Contractors will develop and implement an HIV/AIDS Prevention Programmes for its workforce; with a key focus on HIV/AIDS prevention and treatment programme • The Project will restrict workforce (i.e., migrant workers) access in local communities through closed camp, control over shift rotations, and others. • Develop and implement Workforce Code of Conduct and implement relevant training. Conduct should include measures related to closed camp, prohibiting substance abuse, zero tolerance on illegal activity and prostitution use, illegal gambling, consumption of drugs, fighting and providing guidance on	**MINOR to MODERATE NEGATIVE**

ENVIRONMENT	IMPACT	ASSESSMENT	MITIGATION OR RECOMMENDATIONS	RESIDUAL IMPACT
	A mainly male workforce with a comparatively larger disposable income may engage in sexual activities in local communities, acting as a vector for the disease.		acceptable conduct etc. • The Workforce Code of Conduct should be adhered to by all Contractors. Any Contractor found in violation of the Code should face disciplinary hearing which should potentially result in dismissal. • Contractors should ensure that they have sufficient capacity and capability to care and treat any HIV-positive employees. • Contractors should ensure there is access to free condoms (including female condoms) at the worker camp to promote safe sexual practices. • In partnership with local health officials and relevant NGOs, Contractors should undertake information, education and communication campaigns around safe sexual practices and transmission of STIs and HIV/AIDS. • In partnership with local authorities and relevant NGOs Contractors should support women's empowerment and education programmes to promote women's rights and safe sexual practices (including the use of condoms and female condoms) and support.	

Additional less significant impacts are associated with –

Physical Environmental Impacts

- Increased erosion and sedimentation from the removal and disturbance of vegetation and soil as well as blasting activities.

Biophysical Environmental Impacts

- Destruction and/or disturbance of sensitive habitats due to rehabilitation works.

- Potential exposure and scaring of fauna in the Project area due to increased road traffic, night time lighting, and noise levels from vehicles, generators, etc.

Social Impacts

- A change to the visual landscape of the area. This change is most likely to be experience at key vantage points by tourists coming to visit the dam.

- Effects on fishery resources as a result of decreased water quality downstream.

Detailed mitigation measures for the above impacts have been included in the environmental and social management plan. The Kariba Dam Rehabilitation Project will also be carried out in compliance with the OP/BP 4.37 on Safety of Dams with the Project aimed at ensuring appropriate measures are implemented and sufficient resources provided to ensure the continued safety of the dam. As per OP/BP 4.37 an independent Panel of Experts will be appointed to review the investigations, design, and implementation of the rehabilitation works. Moreover, in the event that the proposed Project undergoes any substantive design / technology changes that might potentially alter the ESIA findings will be subject to re-assessment, further stakeholder consultation, supplementary reporting and revision of the ESMP. Typically, such substantive changes will be submitted to the ZEMA and EMA as an addendum to this ESIA, and will need to go through an approval process in accordance with Section 105 of the Zimbabwean Environmental Management Act, (Chapter 20:27) and the Zambian Environmental Impact Assessment Regulations No 28 of 1997.

Provided that all the mitigation/management commitments provided in the environmental and social management plan are implemented, it is the opinion of ERM that there are no environmental or social fatal flaws which inhibit authorisation of the proposed Kariba Dam Rehabilitation Project.

An important aspect of this Project is the updating of the existing Kariba Dam Emergency Preparedness Plan. The lack of an adequate emergency response plan for such a project is significant and cannot be understated. Accordingly, the ZRA have engaged and appointed a consulting firm to carry out a Dam Break Analysis (DBA) of dams (including the Kariba Dam) along the Zambezi River. The DBA forms part of the risk management plans for Kariba Dam and is aimed to inform the process of updating the existing Kariba Dam Emergency Preparedness Plan. The updating of the DBA is complimentary to the key recommendations of this ESIA.

Approved: ______________________________________

Date: ____

1 INTRODUCTION

1.1 TERMS OF REFERENCE

The Zambezi River Authority (ZRA) has appointed Environmental Resources Management Southern Africa (Pty) Ltd (ERM) in partnership with Black Crystal Consulting (Pvt) Ltd (Zimbabwe), as independent environmental consultants to undertake the Environmental and Social Impact Assessment (ESIA) process for the proposed Kariba Dam Rehabilitation Works. The dam is located on the Zambezi River on the border of Zambia and Zimbabwe and is managed by the ZRA. During the last 20 years, the sluices which make up the spillway have undergone ageing effects and the plunge pool has undergone erosion. The Kariba Dam Rehabilitation Works will consist of excavation works within the plunge pool to stabilise the foundation of the dam wall, as well as refurbishment works to the spillway.

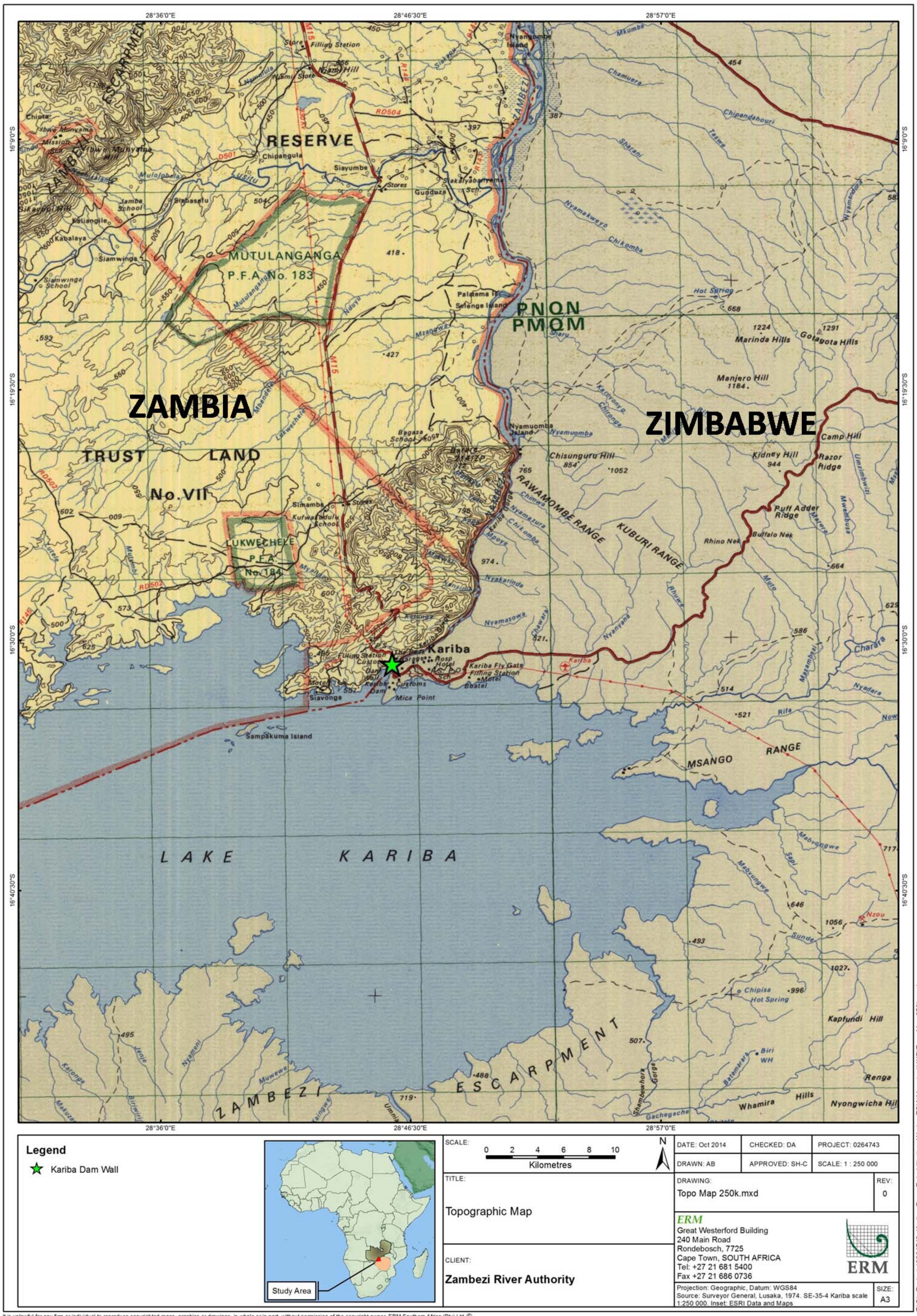
1.2 PROJECT BACKGROUND

The Kariba Dam is a double curvature concrete arch dam located at 16°31′18″S 28°45′41″E in the Kariba Gorge of the Zambezi River Basin between Zambia and Zimbabwe (*Figure 1.1* and *Figure 1.2*). The arch dam was constructed between 1956 and 1959 and supplies water to two underground hydropower plants located on the north bank in Zambia and on the south bank in Zimbabwe (refer *Figure 1.3*). The north bank power station was commissioned in 1960 and the south bank power station in 1976.

Water is released from the reservoir through six sluice gates located approximately 80 m above the river level downstream of the dam. In the first 20 years after the dam was constructed there were sustained heavy spillage episodes resulting in erosion of the bedrock to 80 m below the normal water level. This area is known as the 'Plunge Pool' (*Figure 1.3*). If not addressed, the plunge pool will begin to present a significant risk to the stability of the dam wall.

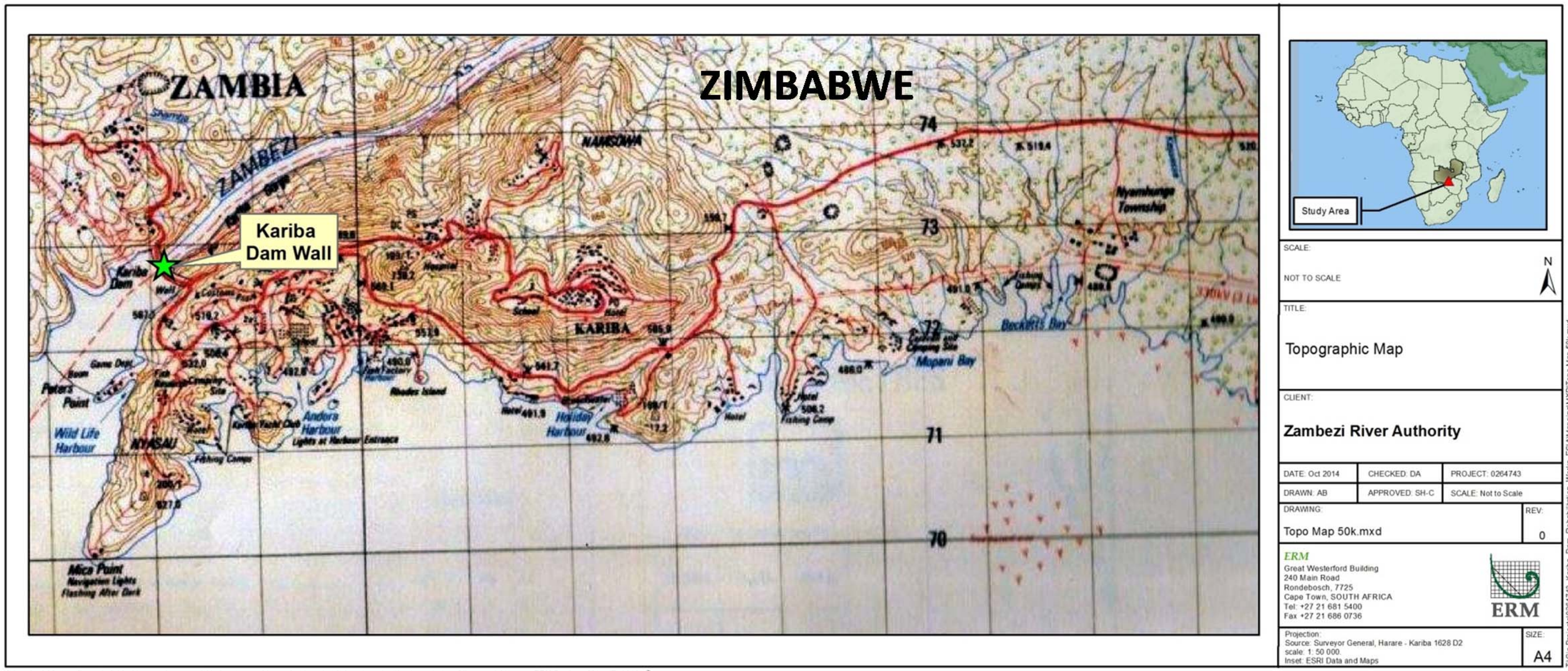
Failure to implement remedial measures to the plunge pool will result in the failure to operate the reservoir as expected (i.e. at a reduced capacity) and an increase in the risk of dam wall failure. A scenario where the dam wall fails will release a flood event of a total 273 km^3 resulting in a major loss of life as the flood plain is home to approximately three million people; loss of livelihoods (socio-economic activities); environmental degradation; and a loss of main source of power to the region. Therefore it is necessary to implement the remedial action to avoid such an event.

Figure 1.1 Kariba Dam Location 1:250 000 Scale



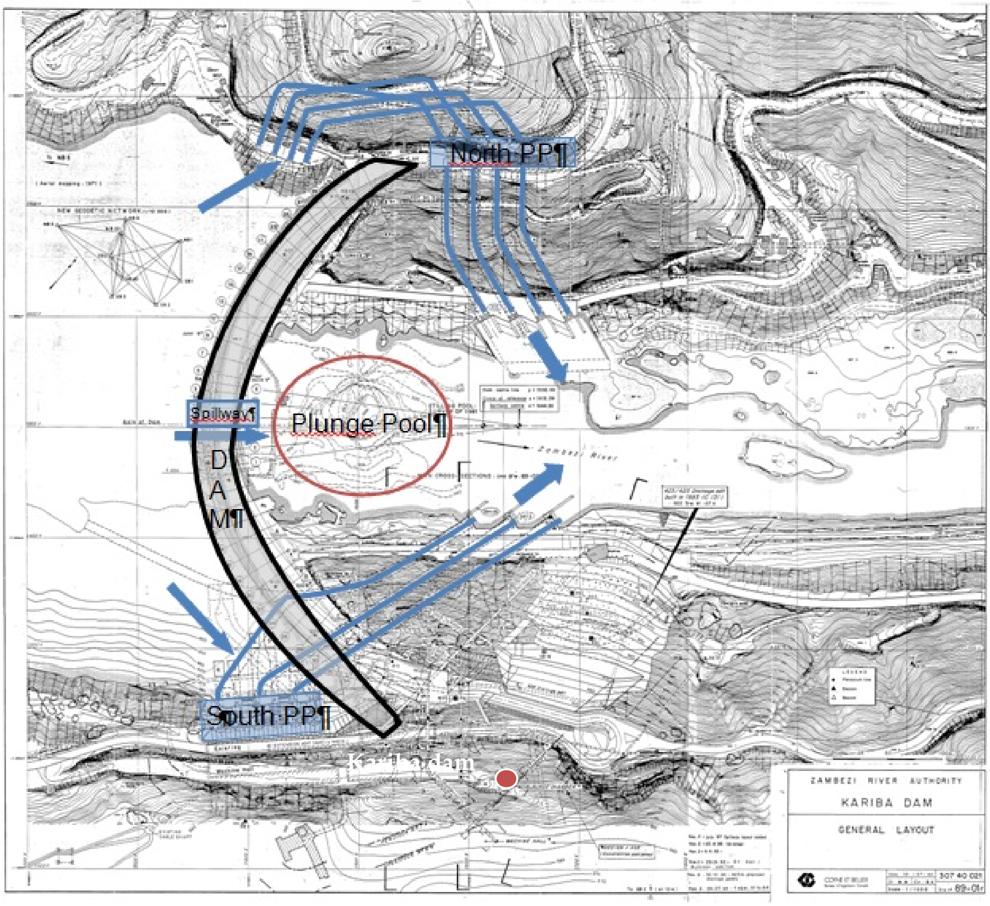
Projection: Geographic, Datum: WGSB4
Source: Surveyor General, Lusaka, 1974, SE-35-4 Kariba scale
1:250 000. Inset: ESRI Data and Maps

Figure 1.2 Kariba Dam Location 1:50 000 Scale



Source: Surveyor General, Harare- Kariba 1628 D2
Scale: 1:50 000
Inset: ESRI Data and Maps

Figure 1.3 Layout of the Kariba Dam



Source: Tractebel Engineering, 2014

Apart from the need to reshape the plunge pool, there is also a need to rehabilitate the six sluice gates that make up the spillway. The work needed within the sluices is associated with the refurbishment of the concrete surface of all sluices, which have been distorted over the years due to an advanced alkali-silica reaction. Without functional sluices, the reservoir level cannot effectively be maintained to take into account the flood regime of the Zambezi River. Without the ability to release water from the reservoir, there is a danger of the reservoir being too full prior to a flood event, and the subsequent flood event causing over topping of the dam wall which could lead to dam failure.

Reshaping and stabilization of the Kariba Dam Plunge Pool and rehabilitation of the spillway is estimated to cost US$ 80 million and US$ 140 million respectively. Both rehabilitation activities will commence in 2015 and are expected to be completed in 2018 and 2022 respectively.

1.3 PROJECT OBJECTIVES

The Kariba Dam Rehabilitation Works has two main objectives. The first objective is to improve the stability of the plunge pool through reshaping its profile. This will limit the preferential erosion towards the foundations of the dam wall along zones of weak rock and allow for the safe operation of the dam and continued generation of electricity from the hydropower plants. The second objective of the project is to rehabilitate the six sluice gates of the spillway, enabling the ongoing use of the spillway function to safely manage the reservoir levels.

1.4 PROJECT PROPONENT

The Zambezi River Authority (ZRA), a corporation jointly and equally owned by the governments of Zambia and Zimbabwe, is the project proponent for the proposed Kariba Dam Rehabilitation Works.

ZRA was formed by the Zambezi River Authority Act of 1987 (Act No. 17 and 19 Zambia and Zimbabwe respectively) and is governed by a Council of Ministers consisting of four members: two are Ministers in the Government of the Republic of Zambia; and two are Ministers in the Government of Zimbabwe. The Ministers are those holding portfolios of Energy and Finance in the respective countries.

The functions of ZRA are set out in the schedule to the Act, and are as follows [(1)]:

- Operate, monitor and maintain the Kariba Complex ("Kariba Complex means: the Kariba Dam and reservoir, all telemetering stations relating to the Kariba Dam, any other installations owned by the Authority").

- In consultation with the National Electricity Undertakings, investigate the desirability of new dams on the Zambezi River and make recommendations thereon to the Council.

- Subject to the approval of the Council, construct, operate, monitor and maintain any other dams on the Zambezi River.

- Collect, accumulate and process hydrological and environmental data of the Zambezi River for the better performance of its functions and for any other purpose beneficial to the Contracting States.

- In consultation with the National Electricity Undertakings, regulate the water level in the Kariba reservoir and in any other reservoir owned by the Authority.

- Make such recommendations to the Council as to ensure the effective and efficient use of the waters and other resources of the Zambezi.

(1) ZRA, 2014, Functions, http://www.zaraho.org.zm/functions.html

- Liaise with the National Electricity Undertakings in the performance of its functions that may affect the generation and transmission of electricity to the Contracting States.

- Subject to provisions of Article 13 of the Act, recruit, employ and provide for the training of such staff as may be necessary for the performance of its functions under the Agreement.

- Submit development plans and programmes to the Council for approval.

- Give effect to such directions, as may from to time, be given by the Council.

- Carry out such other functions as are provided for the Agreement or are incidental or conducive to the better performance of its functions.

The proponent contact details in the application are:

Zambezi River Authority (ZRA),
Contact Person: Eng. Christopher Chisense, Director - Water Resources and Environmental Management
Zambezi River Authority
P. O. Box 30233, Lusaka, Zambia.
Telephone: +260 211 238665
Fax: +260 211 227 498
Email: zaraho@coppernet.zm

1.5 PURPOSE OF THIS REPORT

The Kariba Dam Rehabilitation Works Project is not a scheduled activity under the Zambian and Zimbabwean Environmental Legislation (1); however, the ZRA has committed to comply with international guidelines and standards, and as such is required to undertake a full ESIA for the Project.

In addition to international guidelines and standards, the ESIA will conform and meet the environmental regulatory requirements for both Zambia and Zimbabwe. For Zambia this includes the Environmental Management Act (Act 12 of 2011) and the Environmental Impact Assessment Regulations (No. 28 of 1997), and for Zimbabwe this includes the Environmental Management Act (Chapter 20:27), No. 13 of 2002 and the Environmental Management (Environmental Impact Assessment and Ecosystem Protection) Regulations No. 7 of 2007.

As per the agreed outcomes in a meeting held with the Zambian and Zimbabwean Environmental Management Authorities (dated 24 November 2014, held at the ZRA Administrative Block in Kariba), in which the

(1) Please note that the legislation does list activities associated with the construction of dams; however, not with the rehabilitation/refurbishment of dams.

implementation of a harmonised ESIA process was discussed, a joint ESIA Report (this report) must be submitted to both Environmental Authorities for review. The objective of this ESIA is to assess the potential environmental and social impacts associated with the rehabilitation of the Kariba Dam.

This ESIA Report fulfils both the Zambian and Zimbabwean requirements.

In addition to Zambian and Zimbabwean legal requirements, this ESIA conforms to international standards and best practices, in particular the requirements of the African Development Bank, the World Bank Group, the International Finance Corporation (IFC) and the Equator Principles. The ESIA also conforms with other international guidelines and standards directly applicable to dam-building and hydropower projects such as the World Commission on Dams (WCD), the International Hydropower Association (IHA) guidelines and the Southern African Power Pool (SAPP) environmental and social impact assessment guidelines.

1.6 THE ESIA PROCESS TO DATE

The Zambian and Zimbabwean ESIA process is made up of a number of procedural steps, as prescribed in the Zambian EIA Regulations under the EPPCA (Statutory Instruments No. 28 of 1997) and in the Zimbabwean Environmental Impact Assessments and Ecosystems Protection Regulations under the Environmental Management Act (No. 13 of 2002).

The process undertaken to date is as follows:

1. **Scoping** – the objective of this phase was to present a description of the proposed Project, the ESIA process, relevant legislation, the physical, biological and social characteristics of the Project Area of Influence and surrounds, perceived issues and an outline of the Terms of Reference (ToR) for the various specialist studies that will assess the identified environmental and social issues. During this phase, interested and affected parties and key stakeholders were identified and provided with an opportunity to raise any interim comments/concerns/queries that they may have with the proposed Project. This Scoping/Prospectus Report fulfilled the Zambian requirements for a Scoping Report and Zimbabwean requirements for a Prospectus report, and has since been approved by the Zambian Environmental Management Agency (ZEMA) on 27 February 2015 (reference number: ZEMA/INS/101/04/1) and the Zimbabwean Environmental Management Agency (EMA) on 02 March 2015 (reference number: 17/1/1/3A) (refer to *Annex A*).

2. **Environmental and Social Impact Assessment** - this study functions as the main assessing document for the ESIA study and provides a detailed analysis of the potential environmental and social impacts, supported by objective and defendable scientific studies. It forms the basis on which the environmental license/approval is issued.

1.7 *PURPOSE OF THIS REPORT (ESIA REPORT)*

The main objectives of this ESIA report are to present the following:

- A detailed description of the proposed Project and relevant Project alternatives;
- The ESIA process and a detailed legal register of legislation, guidelines and strategies (both national and international) pertinent to the proposed Project and associated ESIA;
- The outcomes associated with stakeholder engagement activities carried out to date;
- A detailed baseline review of the physical, biological and social characteristics of the Project Area of Influence and surrounds;
- An assessment of impacts to the physical, biological and social environments related to activities associated with the proposed Project;
- Mitigation measures and associated management plan that aims to avoid /minimise/manage the severity of identified impacts; and
- An assessment of any cumulative impacts associated with other planned, existing developments in the broader area of the proposed Project.

1.8 *STRUCTURE OF REPORT*

This ESIA is broken up into three Parts. These include:

- **Part I** – ESIA Report;
- **Part II** – Annexure; and
- **Part III** – Environmental and Social Management Plan (ESMP).

Table 1.1 Part I – ESIA Report Structure

Chapter	Contents
Chapter 1 – Introduction	Presents a brief background to the Project and Project Proponent. Moreover, Chapter 1 presents the objectives of the Project and associated ESIA process.
Chapter 2 – Project Rationale	Provides a description of the motivating factors for the Project.
Chapter 3 – Project Description	Includes a detailed description of the proposed activities of the Project.
Chapter 4 – Administrative Framework	Describes the national environmental and social legislative, policy and administrative requirements, as well as international good practise and local development plans and guidelines applicable to the Project
Chapter 5 - ESIA Methodology	Describes the ESIA Process followed for the proposed Project and the associated impact assessment methodology employed
Chapter 6 – Alternatives Analysis	Describes the different subprojects alternatives under consideration.

Chapter	Contents
Chapter 7 - Public Participation Process	Describes the public participation process activities and key stakeholder feedback to date.
Chapter 8 – Environmental and Social Baseline	Provides a detailed baseline assessment of the receiving physical, biological and social environment in the Project Area of influence and surrounds
Chapter 9 – Assessment of Physical, Biological and Social Impacts and Mitigation	Presents the predicted impacts to the physical, biological and social environment as a result of the proposed Project and associated mitigation recommendations
Chapter 11 – Conclusion	Summarises the key findings of the ESIA
Chapter 12 – References	Provides all references used in the ESIA Report.

Table 1.2 Part II - Annexure

Annexure	Contents
Annex A – Scoping/Prospectus Report Approval Letter	Approval letter for the Scoping /Prospectus Report from the Zambian and Zimbabwean Environmental Management Authorities.
Annex B – Scoping/Prospectus Report	A copy of the approved Scoping/Prospectus Report
Annex C – Consultation Materials	Presents all public participation minutes, comments/responses, disclosure material, databases etc.
Annex D – Current ZRA Emergency Preparedness Plan	Presents the Emergency Preparedness Plan to aid the Dam Safety Monitoring Team during an emergency situation or unusual occurrence for Kariba Dam.
Annex E – High Flow Aquatic Assessment Results	Presents the results for the high flow aquatic assessment undertaken during the month of February 2015.
Annex F – Curriculum Vitae	Presents the curriculum vitae of those involved in the ESIA study

Table 1.3 Part III – Environmental and Social Management Plan

Chapter	Contents
Chapter 1 – Overview	Presents purpose and objectives of the ESMP together with its structure.
Chapter 2 – Summary of Project Description	Provides an overview of the Project, namely the reshaping of the plunge pool and rehabilitation of the spillway.
Chapter 3 – Administrative Framework	Presents the national legislation and international good practice applicable for implementation of the ESMP.
Chapter 4 – Identified Environmental and Social Impacts	Summarises the environmental and social impacts identified in the ESIA.
Chapter 5 – Implementation of ESMP	Provides specifics around implementation of the prescribed mitigation measures, including roles and responsibilities, communication channels and requirements for rehabilitation and post-rehabilitation activities.
Chapter 6 – Environmental and Social Management Plans	Presents the management plans for various physical, biological and social aspects.
Chapter 7 – Monitoring Plans	Presents detailed monitoring plans by which all mitigation measures (included in *Chapter 6*) can be monitored.

Chapter	Contents
Chapter 8 – Costs of Mitigation	Includes an estimate of costs for implementing the environmental and social management plans and associated monitoring.

2 *PROJECT DESCRIPTION*

This *Chapter* provides an overview of the technical features of the proposed Kariba Dam Rehabilitation Works. The information in this *Chapter* has been sourced from the *Plunge Pool Reshaping Detailed Design Report* (2014) and the *Emergency Gate and New Gantry Detailed Design Report* (2012) prepared by Tractebel Engineering /Coyne et Bellier. ZRA has appointed Tractebel Engineering (FRANCE) and Coyne et Bellier to conduct the detailed design and construction supervision of the Kariba Dam Rehabilitation Works.

2.1 *PROJECT LOCATION*

The Kariba Dam is a double curvature concrete arch dam located at GPS co-ordinates: 16°31′18″S 28°45′41″E in the Kariba Gorge of the Zambezi River Basin between Zambia and Zimbabwe (refer to *Figure 1.1* and *Figure 1.2* in *Chapter 1*). It is situated 130 km (in a straight line) south-south-east of Lusaka (Zambia), and 280 km (in a straight line) north-west of Harare (Zimbabwe). The closest towns are Kariba in Zimbabwe and Siavonga in Zambia. Both are located along the lakeshore.

The international road M15 crosses the Zambia-Zimbabwe border on the Kariba Dam crest. Therefore, the site can be reached from both banks, i.e. from Zambia and from Zimbabwe.

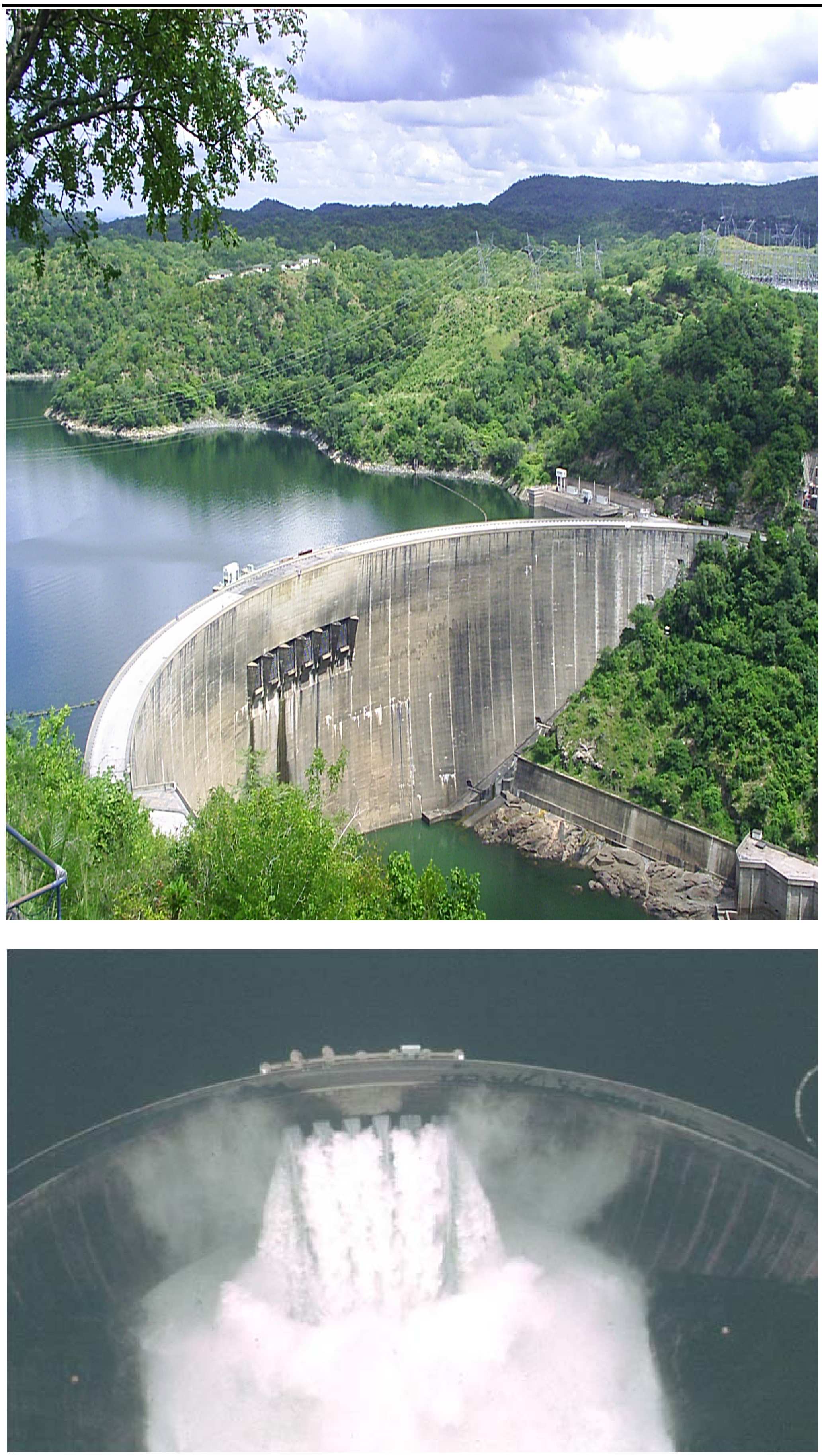
All necessary equipment and material for the works will likely be brought on site by way of these two major roads. However, at this stage the exact transport route to import all equipment is unknown.

2.2 *BACKGROUND TO KARIBA DAM*

The Kariba Dam is a double curvature concrete arch dam that was constructed between 1956 and 1959 together with two separate hydropower plants: one on the Zambian side and one on the Zimbabwean side of the Zambezi River (*Figure 2.1*). The dam creates the largest artificial lake in the world (181 km^3).

The dam has a height of 128 m (H) with a crest length and thickness of 716 m and (T_C) 13 m respectively. Furthermore, the dam has a base thickness (T_B) of 26 m and has a spill capacity of 9,000 m^3/s (*Figure 2.2*). While the construction of the dam was completed in 1959 it reached capacity for the first time in 1963. The reservoir has a storage capacity of 181x109 m^3; however, only the upper 13 m of storage is available for power generation. The catchment area for the reservoir is approximately 663,820 km^2 with the total length of the reservoir estimated at 280 km. Water is released from the reservoir through six sluice gates located approximately 80 m above the river level downstream of the dam (*Figure 2.1*).

Figure 2.1 Kariba Dam Wall



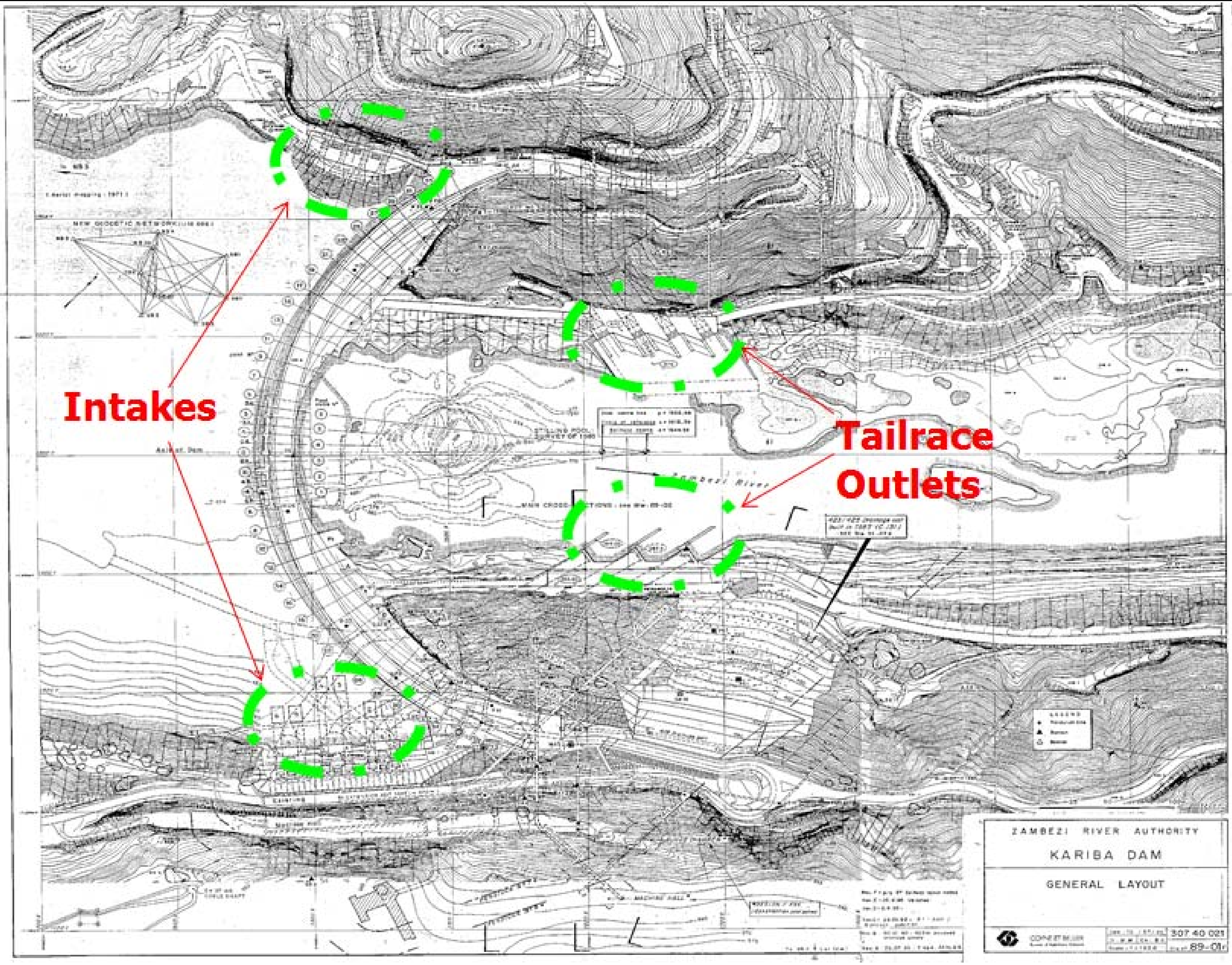
Source: ZRA, 2014.

Figure 2.2 Dimensions of the Kariba Dam Wall

Source: ZRA, 2014.

Power from the reservoir is generated through two underground power stations located on the North (left) bank in Zambia and on the South (right) bank in Zimbabwe (*Figure 2.3*). There are twelve turbines, six on either side of the Zambezi River. More specifically 6 x 125 MW (750 MW) on the South bank and 6 x 180 MW (1,080 MW) (four old and two recently commissioned) on the North bank. The combination of these turbines produces 6,400 MWh per annum.

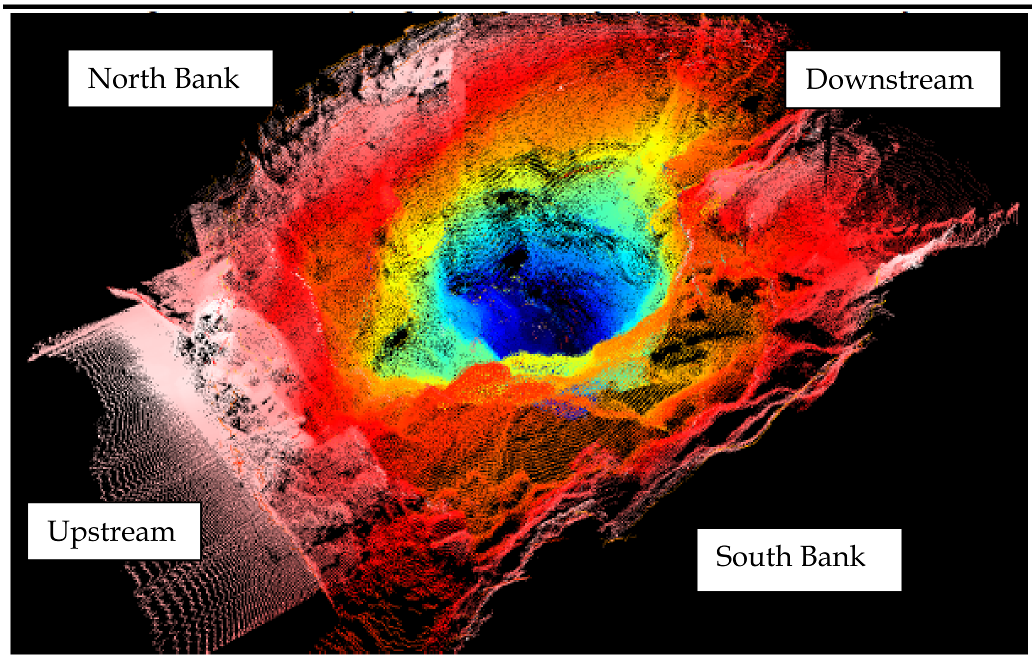
Figure 2.3 General Layout of the Kariba Dam Hydropower Facility



Source: ZRA, 2014.

In the first 20 years after the dam was constructed there were sustained heavy spillage episodes resulting in erosion of the bedrock to 80 m below the normal water level within the 'Plunge Pool'. *Figure 2.4* below shows the results of a three dimensional (3-D) Multi-beam Bathymetric Survey undertaken in order to map the plunge pool. The plunge pool represents a risk to the stability of the dam wall and therefore risk of a flood event and reduced operating capacity of the dam.

Figure 2.4 *3-D Multi-beam Bathymetric Survey of the Plunge Pool*



Source: Tractebel Engineering France /Coyne et Bellier, 2014

Apart from the need to rehabilitate the plunge pool, there is also a need to rehabilitate the six sluice gates that make up the spillway. The work needed within the sluices is associated with the refurbishment of the concrete surface of all sluices which have been distorted over the years due to an advanced alkali-silica reaction. Without functional sluices the reservoir level cannot effectively be maintained to take into account the flood regime of the Zambezi River. Without the ability to release water from the reservoir, there is a danger of the reservoir being too full prior to a flood event, and the subsequent flood event causing over topping of the dam wall which could lead to dam failure.

The aim of the Kariba Dam Rehabilitation Works is to improve the stability of the plunge pool through reshaping its profile. This will limit the preferential erosion towards the foundations of the dam along zones of weak rock. The project also aims to rehabilitate the six sluice gates of the spillway, enabling the ongoing use of the spillway function to manage the reservoir levels.

PLEASE NOTE:

The two key components of the rehabilitation works, namely the rehabilitation of the plunge pool and the spillway, are discussed in more detail in *Section 2.4* (*Page 2-9*) and *Section 2.5* (*Page 2-20*).

2.3 *AREA OF INFLUENCE*

The definition for "*Area of Influence*" (AoI) used in this Report is from the African Development Bank's Integrated Safeguards System (The World Bank's [(1)] definition is similar and included as a footnote). According to the African Development Bank:

> *The project's AoI is delineated and explicitly covered in any impact assessment. The AoI encompasses the following, as appropriate:*
>
> - *The area likely to be directly affected by the project;*
> - *Related or associated facilities dependent on the project that are not funded by the project and that would not have been implemented if the project did not exist; and*
> - *Areas, including the communities within them, potentially affected by unplanned but technically predictable activities likely to be induced by the project.*

After analysing the Project, the Direct AoI has been defined to be areas falling inside 5 km of the dam wall. This is limited to 5 km, as the vast majority of the Project impacts will be experienced in very close proximity to the dam wall and immediate surrounds. There are two activities that may have a direct impact greater than 5 km, namely –

1. **<u>The transport of construction materials to the site</u>** – as the transport routes are outside of the scope of this Project, recommendations as to the safe transport of construction materials will be included in the Framework ESMP.

2. **<u>Possible Changes to the Spilling Regime</u>** – may have an influence greater than 5 km downstream of the dam wall; however it is not envisaged at this stage that the change in spill regime will be outside of the parameters that have been followed in the past. As a result, it is not expected that sensitive receptors downstream of the dam wall will be impacted.

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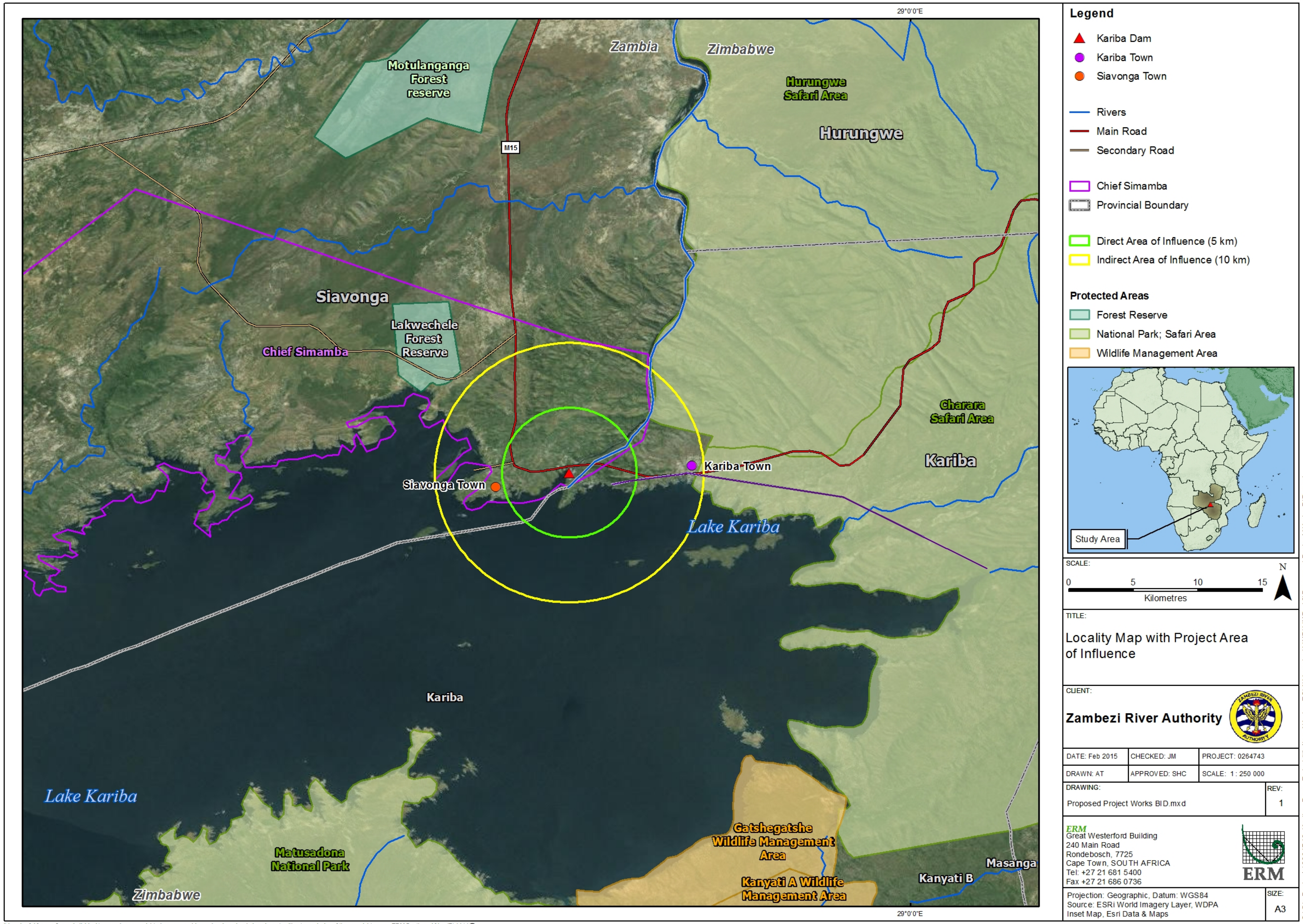
(1) World Bank AoI: Project area of influence: The area likely to be affected by the project, including all its ancillary aspects, such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, and construction camps, as well as unplanned developments induced by the project (e.g., spontaneous settlement, logging, or shifting agriculture along access roads). The area of influence may include, for example, (a) the watershed within which the project is located; (b) any affected estuary and coastal zone; (c) off-site areas required for resettlement or compensatory tracts; (d) the airshed (e.g., where airborne pollution such as smoke or dust may enter or leave the area of influence; (e) migratory routes of humans, wildlife, or fish, particularly where they relate to public health, economic activities, or environmental conservation; and (f) areas used for livelihood activities (hunting, fishing, grazing, gathering, agriculture, etc.) or religious or ceremonial purposes of a customary nature.

An area of up to 10 km around the dam wall constitutes the Indirect AoI. *Figure 2.5* below indicates the currently defined AoI boundaries of the Project. From an ecological (terrestrial and aquatic) perspective the Indirect Ecological Area of Influence extends about 20km downstream of the Kariba Dam wall, but this is specifically downstream and confined to the river channel.

After discussions with the World Bank, the African Development Bank and the ZRA at the initial Project meeting (20 August 2014), it was agreed that the Area of Influence associated with unplanned events (for example, catastrophic failure of the dam wall), would not be included in the ESIA. Moreover, stakeholder engagement will not be extended to communities downstream of the dam wall that may be impacted by catastrophic failure. It was suggested that the Emergency Response Plan (current plan is attached to *Annex D* in *Part II* of this ESIA) for the dam is being updated by the ZRA and that stakeholder engagement with downstream communities would be carried out as part of this study by the ZRA. However, this said, this ESIA will consider dam safety issues associated with the integrity of the coffer dam during the rehabilitation and subsequent safety of the construction team, instability of dam wall foundations during pumping of water from the plunge pool and integrity of the dam from blasting events during rehabilitation (this is discussed further in *Chapter 7*).

The ZRA have confirmed that there are no land acquisition issues for any land associated with the proposed Kariba Dam Rehabilitation Project.

Figure 2.5 *Locality Map with Project Area of Influence*



2.4 PLUNGE POOL REHABILITATION

This *Section* presents the activities required to rehabilitate the plunge pool. The rehabilitation of the plunge pool aims to address the downstream erosion that could undermine the stability of the dam wall. This rehabilitation will be in the form of an excavation and reshaping of the plunge pool.

The primary aim of reshaping the plunge pool profile is to improve the stability of the plunge pool, limiting preferential erosion towards the foundations of the dam, along zones of weak rock. In order to arrive at the solutions described below the engineering team undertook; Multi-beam Bathymetric Survey of the Pool; Plunge Pool Geotechnical Investigations; and Plunge Pool Hydraulic Modeling.

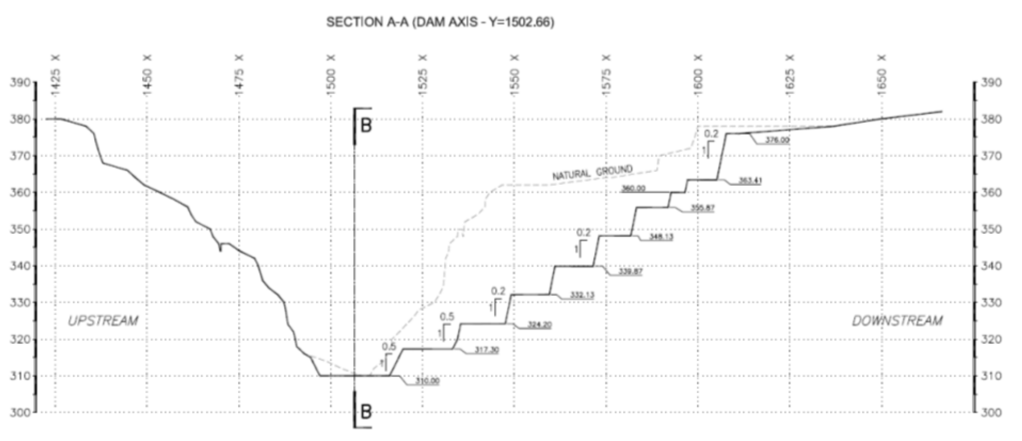
Generally, the rehabilitation of the plunge pool will include a number of activities:

- The construction of a cofferdam just downstream of the plunge pool, which will block off the plunge pool from the downstream river.
- The pumping/dewatering of the plunge pool.
- The excavation of the plunge pool.
- The deposition of excavated rock material in the existing quarry on the north bank.
- The reshaping of the excavated plunge pool into terraced steps.

2.4.1 Banks Stability

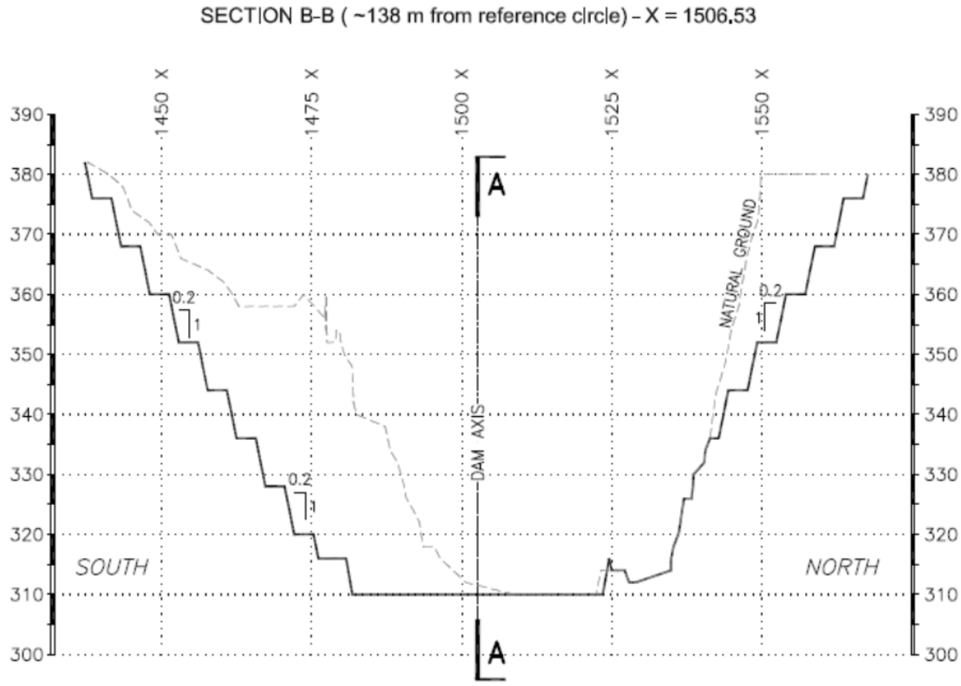
As reshaping the plunge pool will enlarge the natural scour pool by excavation, the slopes of the river banks will be modified. This will be undertaken in a terraced manner as it will reduce dynamic pressures in the pool and reduce flow re-circulation towards the dam toe. *Figure 2.6* and *Figure 2.7* illustrate the terraced slopes through vertical cross-sections.

Figure 2.6 Plunge Pool Reshaping - Vertical Cross Section A-A in the Axis of the River



Source: Tractebel Engineering, 2014

Figure 2.7 Plunge Pool Reshaping - Vertical Cross Section B-B from Right to Left Banks



Source: Tractebel Engineering, 2014

Also, the lowering of the water level in the plunge pool during excavation works could weaken the rock foundation due to de-confinement and loss of balance of water pore pressure.

Tractebel Engineering (2014) carried out geotechnical investigations to establish the stability of both river banks, the dam toe and rock wedges. The geotechnical study of the banks stability established that due to the good quality of the rock both banks are stable.

Along the south bank, two different geological movements were identified from the first reservoir impounding, namely shallow and deep slides. The shallow slide is located 150 m downstream of the plunge pool and 20 m above water table, therefore the plunge pool dewatering will not influence this "shallow" slide. The deep slide is located downstream of the south abutment, with the slip surface exit approximately at 450 m elevation while slip surface enter is around 500 m elevation. Even though this deep slide is closer to the plunge pool than the shallow slide, it is still above the water table, in a dry area, and according to the study will not be influenced by the plunge pool dewatering.

On the north bank, different polyline slip surfaces have been considered, following the observed sub-vertical and sub-horizontal discontinuities on site. For each case minimal safety conditions were considered; and in all cases rapid drawdown creates unstable conditions. Therefore the water level must be lowered in a measured manner in order to maintain balance of pore pressure between the plunge pool and the foundation.

Given the good quality of rock, failure could only occur according to the study along existing discontinuities. Therefore, groundwater level should be cautiously monitored, and discontinuities should be visually checked during the emptying of the plunge pool.

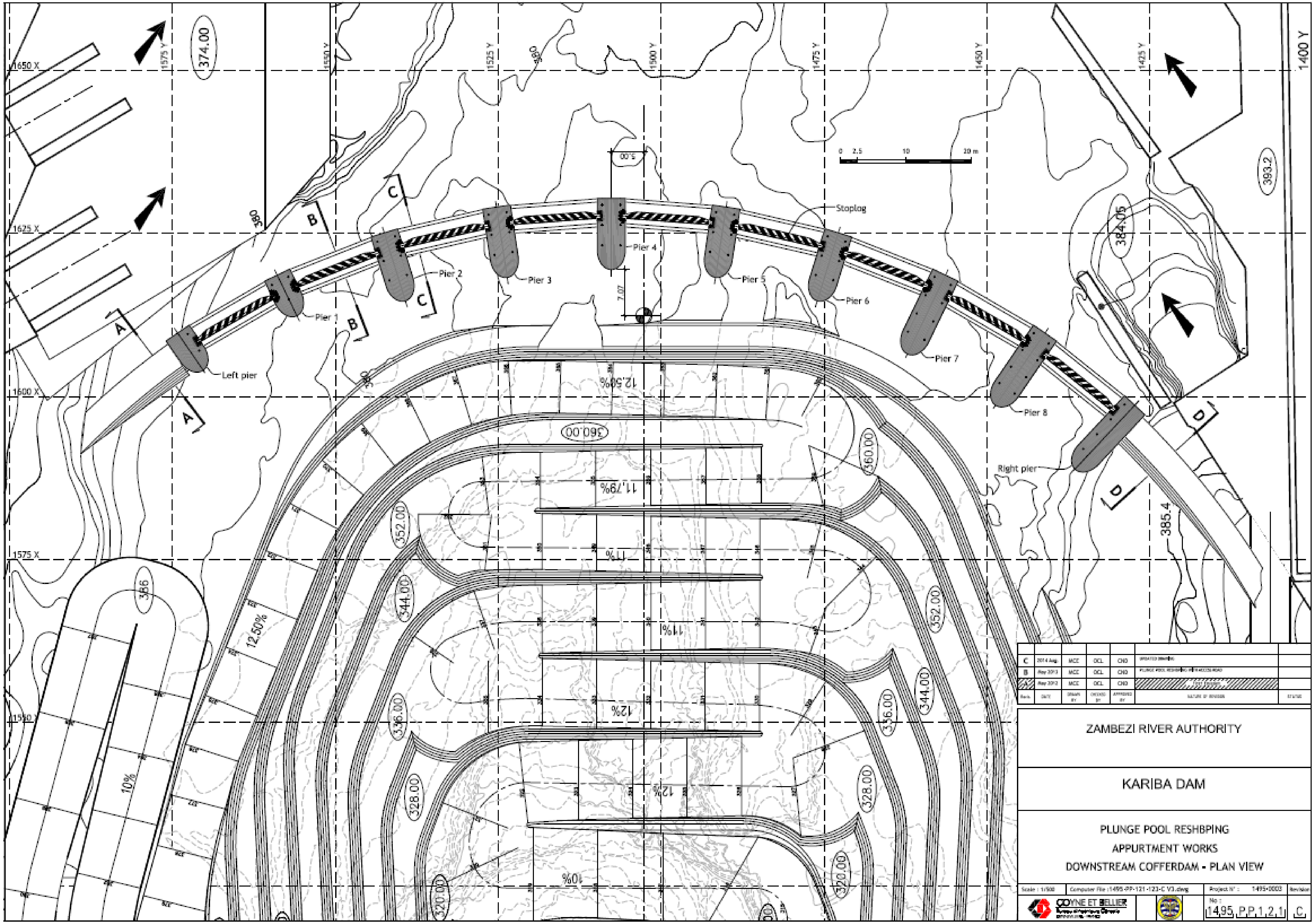
2.4.2 Cofferdam

A cofferdam is a temporary enclosure that will be built across the river downstream of the dam wall just upstream of the turbine outlets. It will be constructed to allow an enclosed area to be pumped out; creating a dry work environment for the work on the plunge pool to proceed. Once the excavation of the plunge pool is complete, the cofferdam will be removed.

Three alternative cofferdam designs were considered (these are presented in *Chapter 6*). The preferred alternative would consist of the establishment of a cofferdam at the beginning of the works, removed at the end of the dry season and then re-installed at the beginning of the following dry season (refer to *Figure 2.8* and *Figure 2.9*). This cofferdam design allows for easier mobilization and demobilization between potential flood events, and allows for a three phase work program.

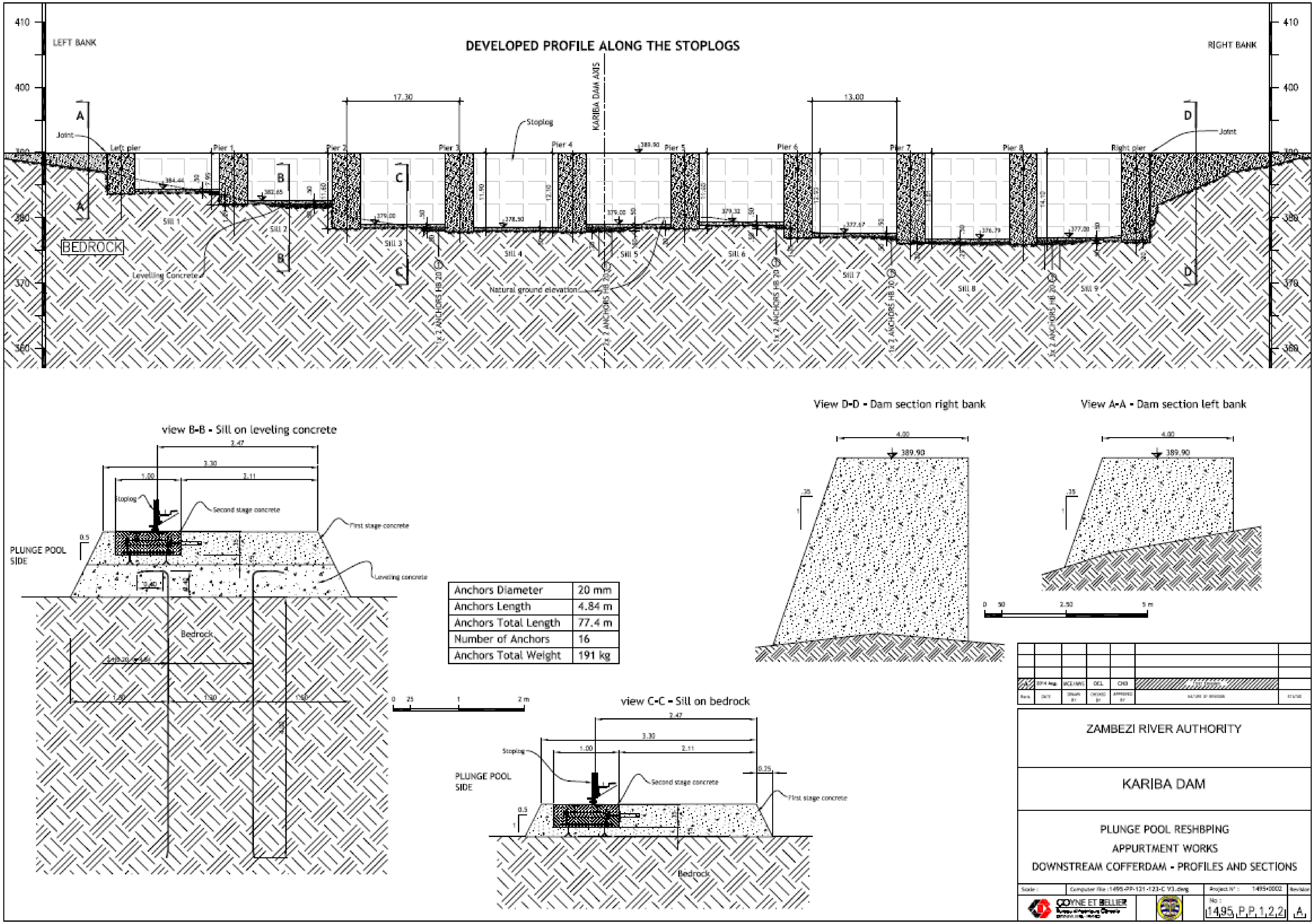
The cofferdam will comprise of 10 piers spaced 13 m apart, with nine stoplogs in between. On both banks a gravity dam will connect the last pier with the bank and the crest of the cofferdam will be 389.9 m. Excavation will be required to flatten the natural ground level and a sill will be constructed between the piers to ensure flat watertight contact between the stoplog and the foundation. Moreover, it is proposed that aggregate material necessary for the construction of the cofferdam will be sourced from two existing permitted quarries.

Figure 2.8 Plan View of Downstream Cofferdam with Piers and Stoplogs



Source: Tractebel Engineering France /Coyne et Bellier, 2014

Figure 2.9 Cross Section of Cofferdam



Source: Tractebel Engineering France /Coyne et Bellier, 2014

2.4.3 *Pumping Operations*

Pumping will commence as soon as the establishment of the cofferdam (detailed in *Section 2.4.2*) is complete and when both power stations are discharging (i.e. tail water level at elevation 388.7 m). The total volume of water to be pumped from the plunge pool is approximately 625,000 m^3.

There are three identified pumping periods:

1. Between the cofferdam closure and the beginning of excavation works. This is estimated to take one month.

2. The plunge pool drawdown, i.e. during excavation works. The pumped out flow will be adapted to the work progress, as long as it does not threaten the banks' stability.

3. When the plunge pool water level will be at its minimal, around 310 m. During this period, the water level will be kept at a constant level and the pumped flow will correspond to the seepage discharge.

It is also anticipated that another pumping system will be set up to discharge leakages along the cofferdam, but it will be independent from pumps into the plunge pool.

2.4.4 *Excavation Works in the Plunge Pool*

Excavation and pumping will be carried out simultaneously. While excavations are being carried out on one of the plunge pool steps, the pumps will keep lowering the water level underneath. The objective is to be able to excavate continuously even when switching from one step to the next one situated below it.

An estimated 295,000 m^3 of rock will be carefully excavated due to the excavation depth below the current Tail Water Level (TWL). The reshaping of the plunge pool into terraced steps (refer to *Figure 2.11*) will reduce dynamic pressures in the pool and reduce flow recirculation towards dam toe. As a result, it is estimated that the power density will be reduced from 25 kW/m^3 to 7.5 kW/m^3. Trial blasts will be carried out, whereby increasing charges of explosives will be fired and the impacts of the vibrations on the surrounding sensitive structures will be measured.

The choice of explosives to be used will be considered very carefully. While ammo-nitrate fuel oil (ANFO) is commonly used as it is inexpensive and has sufficient strength, its water sensitivity is high. It is therefore recommended that surface bulk emulsions are used. Blasting will take place for approximately six months.

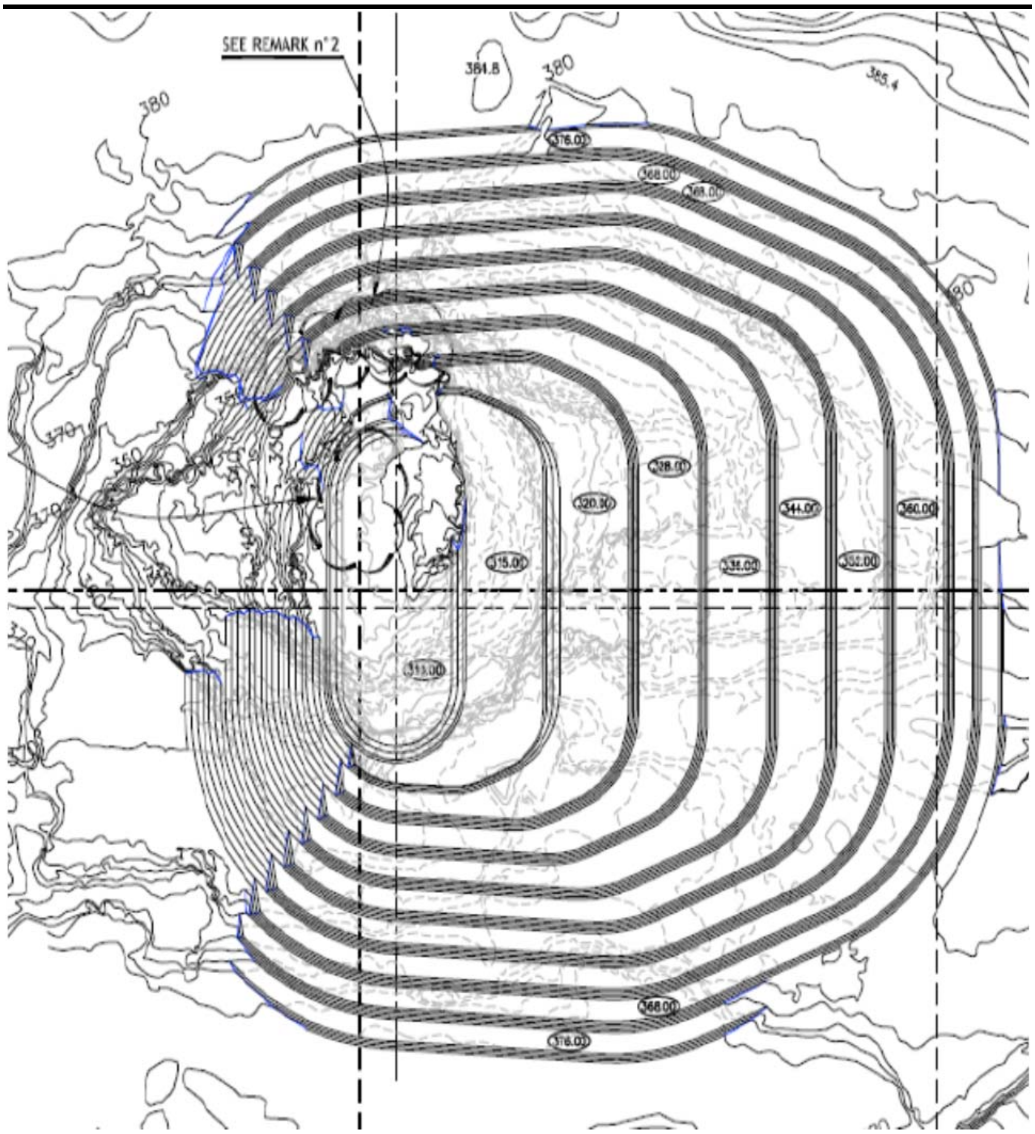
Once the blasting has occurred, material will be removed from the plunge pool and transported to and stockpiled on the north bank in an open quarry pit (about 2.5 km from the plunge pool – refer to the locality of the open quarry pit in *Figure 8.1* in *Chapter 8*).

Once the plunge pool excavation works are completed, some concreting works will be performed to reinforce the weak areas of the plunge pool. This is discussed in more detail in *Section 2.4.5*.

2.4.5 Fault Zone Treatment

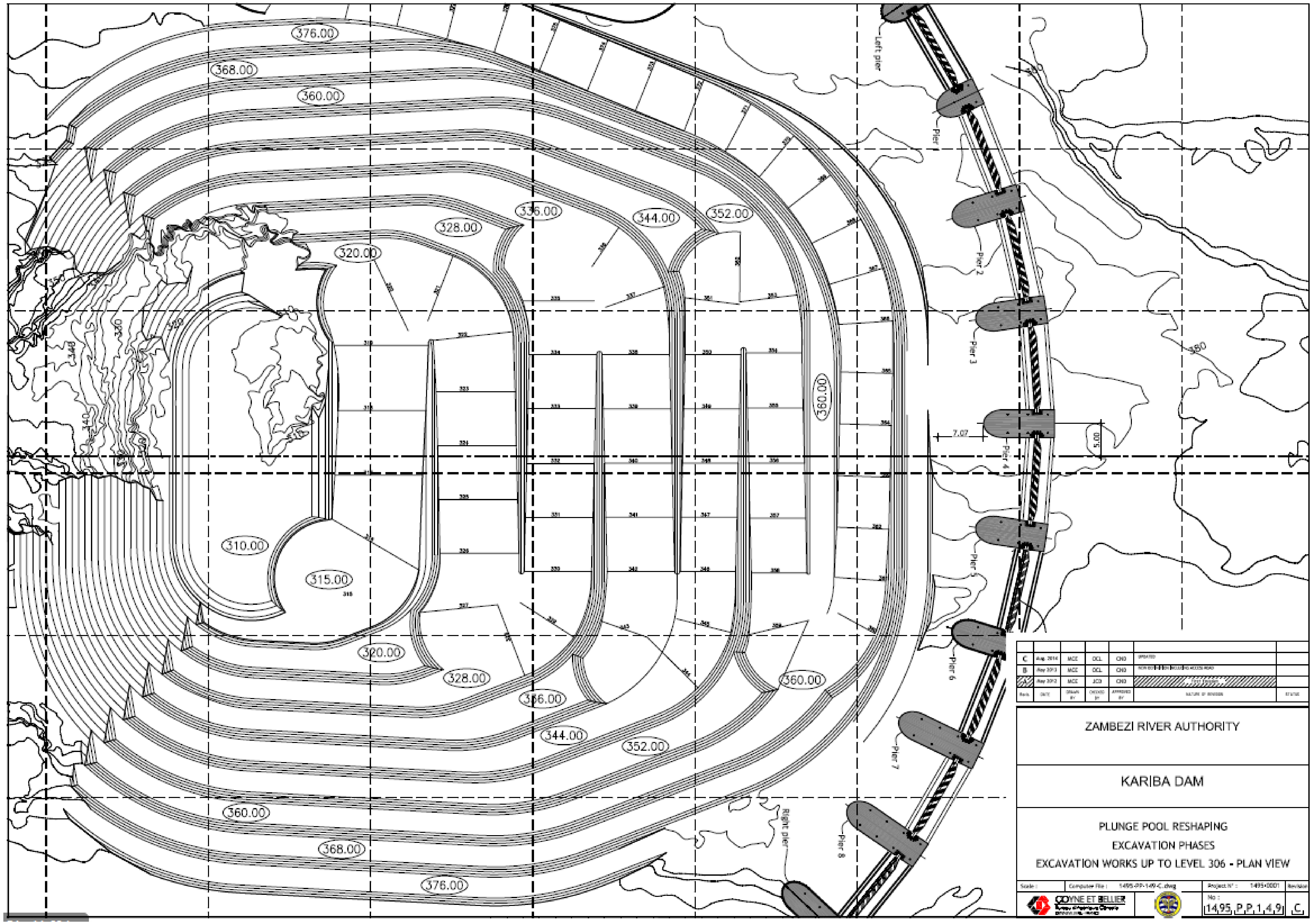
The geological fault in the plunge pool requires a special treatment as it presents an area with a high density of joints. *Figure 2.10* shows the fault axis.

Figure 2.10 Fault Axis on the Target Geometry of the Plunge Pool



Source: Tractebel Engineering France /Coyne et Bellier, 2014

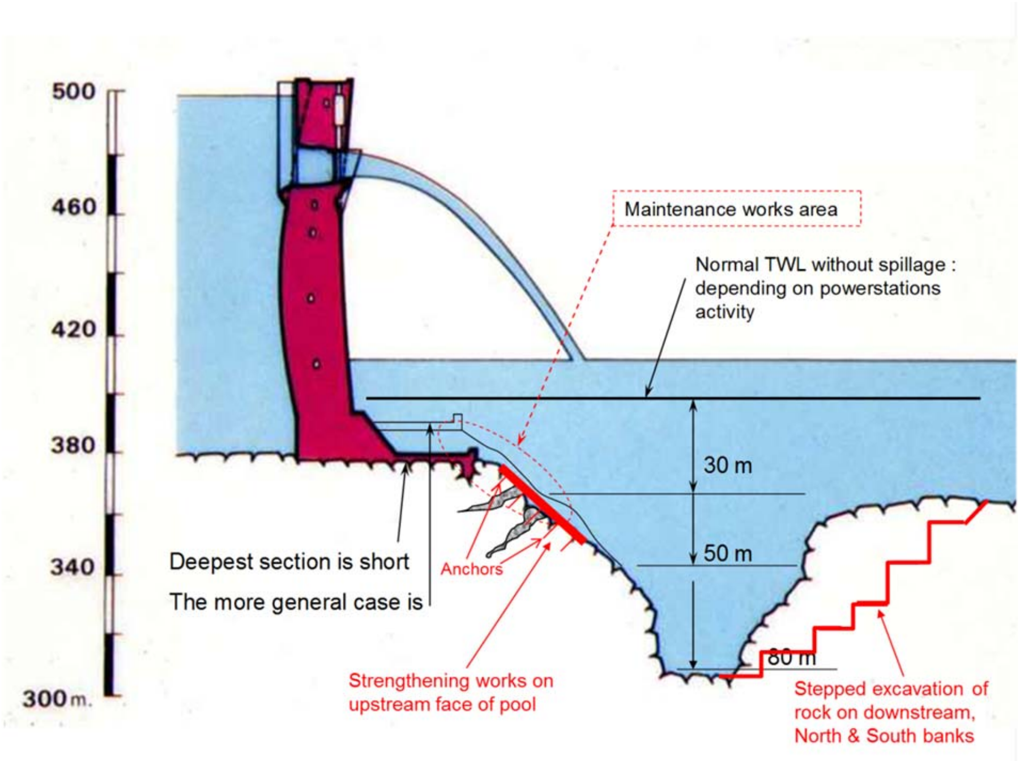
Figure 2.11 Plan View of Plunge Pool Terraced Excavation Works



Source: Tractebel Engineering France /Coyne et Bellier, 2014

As a result the engineers have designed a concrete slab to cover the fault zone along the axis, with an anchoring system, minimising the area that has a point of weakness (see *Figure 2.12*). The anchoring is required to ensure the stability of the concrete slab and will take into consideration the uplift capacity, anchor capacity, rock stability and bond strength in its design.

Figure 2.12 Plunge Pool Reshaping (with upstream strengthening of fault zone)

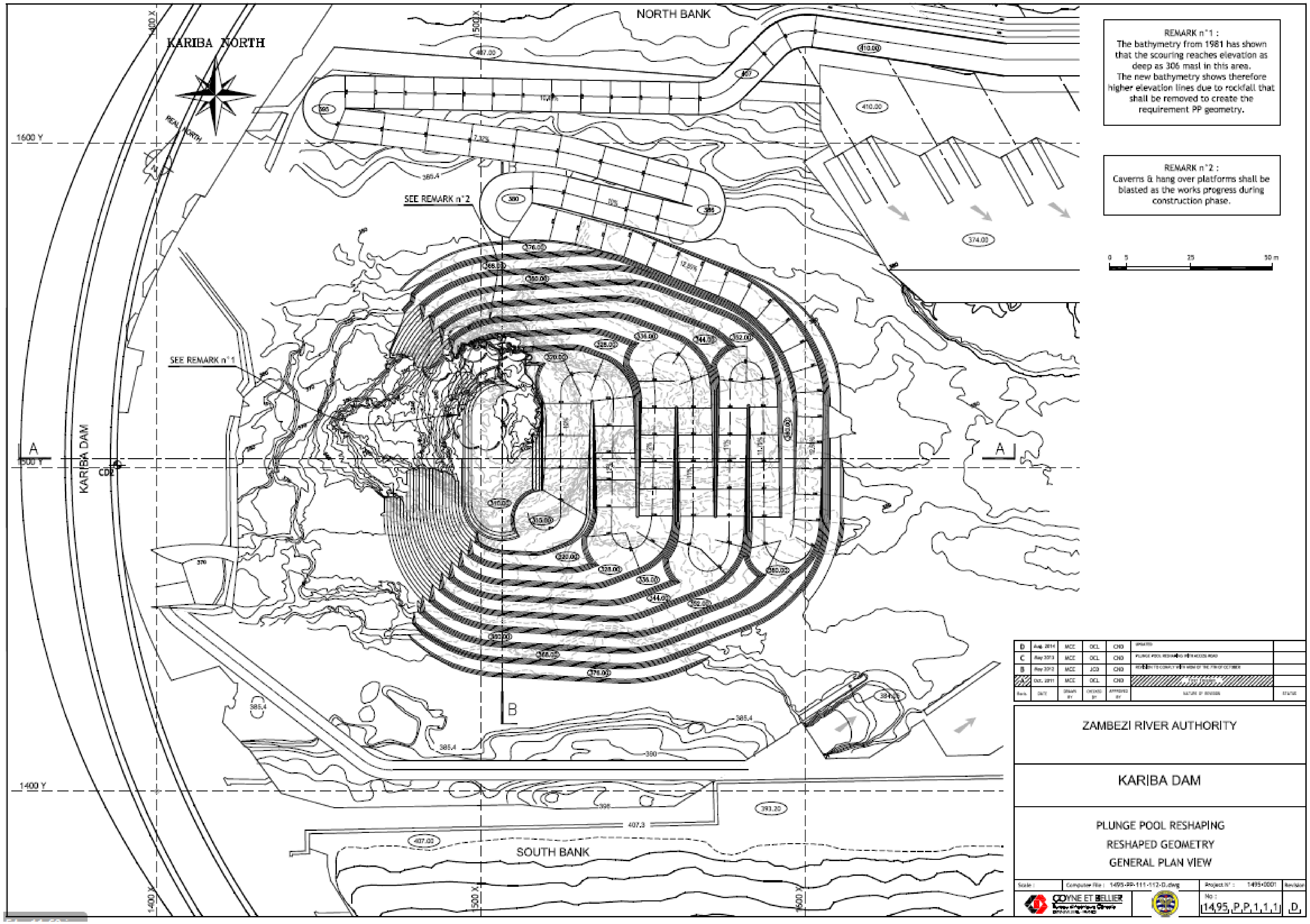


Source: ZRA, 2014.

2.4.6 Access Roads

Access to the plunge pool will be from the existing M15 national road on the north bank, and then the existing tarred road from the M15 down to the north bank turbine outlets. From the turbine outlets a permanent new road approximately 100 m in length and 10 m wide (with additional 5 m safety margin) will be constructed behind the north bank powerhouse to facilitate the rehabilitation works (see *Figure 2.13*). Furthermore, excavation of the slope will be necessary to free a 15 m wide band of flat ground for the construction. *Figure 2.13* below shows the overall plan view of the proposed plunge pool rehabilitation works and access road from the north bank.

Figure 2.13 Overall Plan View of Plunge Pool Rehabilitation Works



Source: Tractebel Engineering France /Coyne et Bellier, 2014

2.4.7 *Integrity Monitoring during Plunge Pool Works*

Existing structures and surroundings must be closely monitored to ensure that they are not damaged by the plunge pool works, specifically from dewatering and blasting. In addition to the vibration monitoring, a monitoring system to reinforce the surveillance of the pore pressure in the rock foundation around the pool and the surveillance of the movement of the dam, its toe and the banks will also be implemented.

2.4.8 *Reservoir Management*

Flood Management

Flood management during rehabilitation is a key feature of this Project.

The three-month peak flood period of the Zambezi River usually takes place from February to April, and is a key constraint on the Project. The spillage season of the Kariba Dam usually takes place from January to August (the spillage season and the high-flood season do not overlap because a reservoir rule curve is applied to provide a sufficient dumping capacity in advance, in order to regulate the high floods). Limited amounts of water are usually spilled every now and then in order to closely match the reservoir level rule from January to August.

Because the works are located at the toe and within the spillway of the dam wall, they must be performed during the non-spillage period, which leaves a short time window.

Several simulations to find optimised scenarios that increase the non-spillage period, and limit consequences on energy production and water availability during and after works were carried out. Three alternative scenarios, based on a series of assumptions, have been retained depending of the duration made available for works. These alternatives are discussed in detail in *Chapter 8*. The preferred option will allow for plunge pool rehabilitation works to be carried out over a period of 7 months, after which time all materials and equipment will have to be dismantled to allow for the 5 months spillage period, before the works can be resumed for another 7 months.

Preparation for Spillage and Recommencement of Works

Before a spillage occurs, all material equipment and workforce shall be removed from the plunge pool, and the cofferdam shall be prepared for a spillage episode. Once the spillage season is over, the cofferdam will be put back in operation and the water will be pumped out of the plunge pool area so that the works can be resumed.

The "preparation" of the cofferdam for the spillage can mean, depending on its design (to be defined by the Contractor), either its complete or partial removal, with either an opening of the gates, or no specific measures being taken if its destruction by the flood is accepted.

When the cofferdam is put back in operation after the spillage, it could consist in either its complete or partial reconstruction, a closing of the gates, or its complete reconstruction with the cleaning of the riverbed if it was destroyed and washed away by the flood.

2.4.9 *Work Schedule*

The work schedule will depend on the spillage duration governed by the specific hydrological conditions during the works. However, based on the preferred scenario presented in *Section 2.4.8* the on-site works to reshape the plunge pool are estimated to take about three and a half years to complete, inclusive of three five-month long spillage seasons.

2.4.10 *Cost Estimates*

The estimated costs for the plunge pool rehabilitation are given below in *Table 2.1.*

Table 2.1 Estimated Plunge Pool Rehabilitation Costs

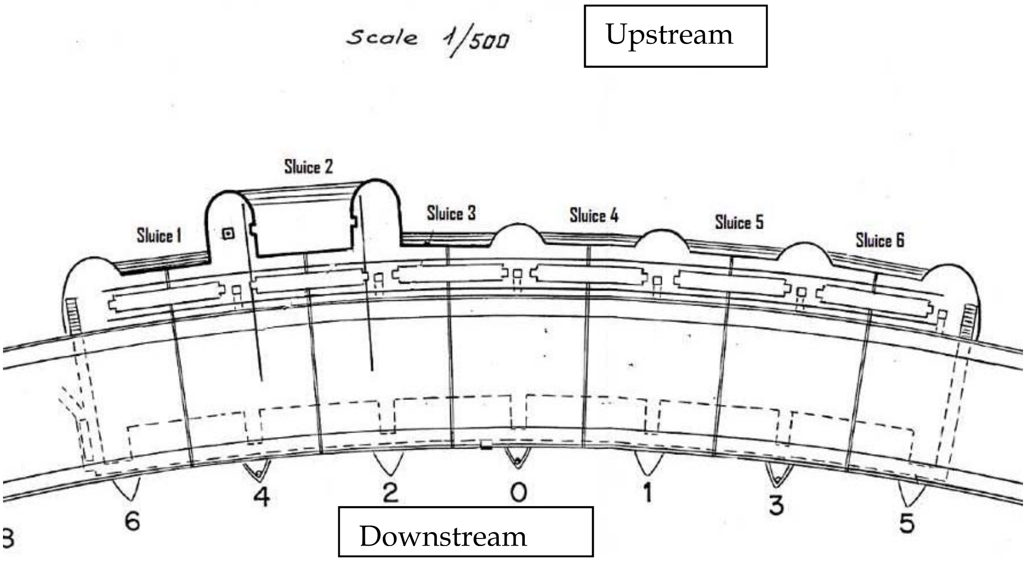
Activity	**Annual Budget ('000 US$)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Amount**
Tendering	452					452
Project Launching	20					20
Construction Supervision	100	580	600	450	528	2,258
Construction Works Design	538	780				1,318
Mobilisation and Site Establishment		21,100				21,100
Cofferdam Construction		10,100	4,000	2,000		16,100
Implementation of Monitoring Instrumentation		670				670
Staged Dewatering of Pool (sync with excavation)		450	350	195		995
Staged Excavation of Pool (sync with dewatering)		3,850	8,450	7,100		19,400
Treatment of Fault Zone				4,860		4,860
Removal of Ramps					1,520	1,520
Removal of the Cofferdam					2,500	2,500
Demobilisation					8,810	8,810
TOTAL BUDGET FOR PLUNGE POOL	**1,110**	**37,530**	**13,400**	**14,605**	**13,358**	**80,003**

Source: ZRA, 2014

2.5 SPILLWAY REHABILITATION

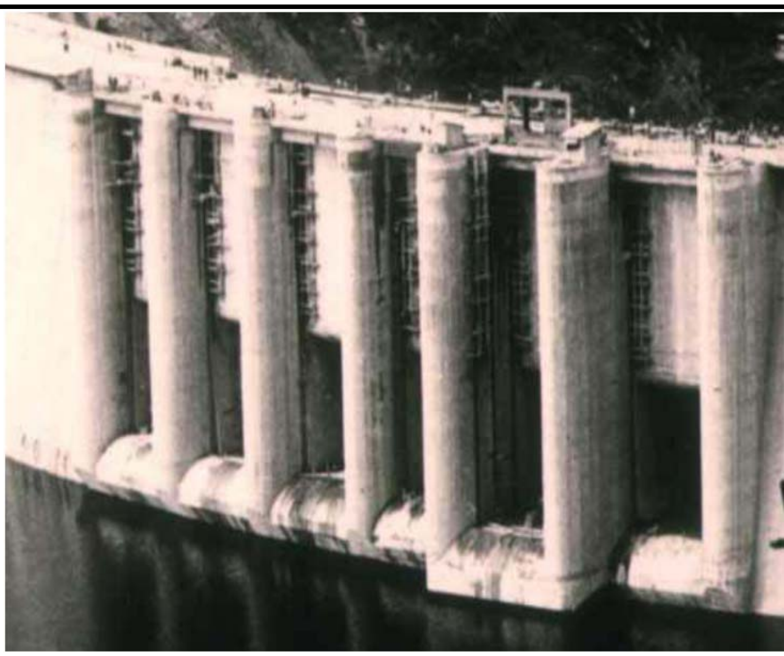
The Kariba Dam Rehabilitation Works also includes the need to rehabilitate the concrete surface of all six sluice gates that make up the spillway of the Kariba Dam. These have been distorted over the years due to an advanced alkali aggregate reaction (AAR) or concrete swelling (particularly vertical swelling). The following section discusses the activities required to rehabilitate the spillway. *Figure 2.14* and *Figure 2.15* below show the layout of the spillway and the six sluice gates.

Figure 2.14 Plan View of the Existing Spillway



Source: ZRA, 2014.

Figure 2.15 Upstream View of Spillway Prior to Dam Filling



Source: ZRA, 2014.

The progressive distortion of the concrete and the built-in parts (BIP) resulting from AAR has caused and is still causing considerable problems for the safe and reliable operation of the emergency gate within the sluice gates. In order to address this concern, refurbishment of the stopbeam civil works in the upstream guide slots of each sluice gate is required; however, the most damage is present in sluice gate 2 due to possible angle of water flow and the different geometry of this sluice.

Furthermore, the original design of the spillway was compromised and avoided the full cost of a large emergency gate to avoid a situation where there was no possible means of closure under flow. However, the lack of reinforcement of concrete parts supporting the stopbeams in the sluice gates evidenced, and the general poor condition of built-in parts and surrounding concrete means that the compromise solution is no longer viable. Therefore, the design, fabrication and installation of an emergency gate and new gantry are proposed.

The main works regarding the spillway refurbishment includes the assemblage and transport of a floating cofferdam (discussed in *Section 2.5.1*) for the dewatering of sluice gates 1 and 3 to 6. The existing stopbeams will be used to create a cofferdam for sluice gate 2, due to the different geometry associated with its waste disposal function. Refurbishment works associated with sluice gate 2 is discussed in *Section 2.5.3*.

Generally, the following activities will be required for the spillway rehabilitation:

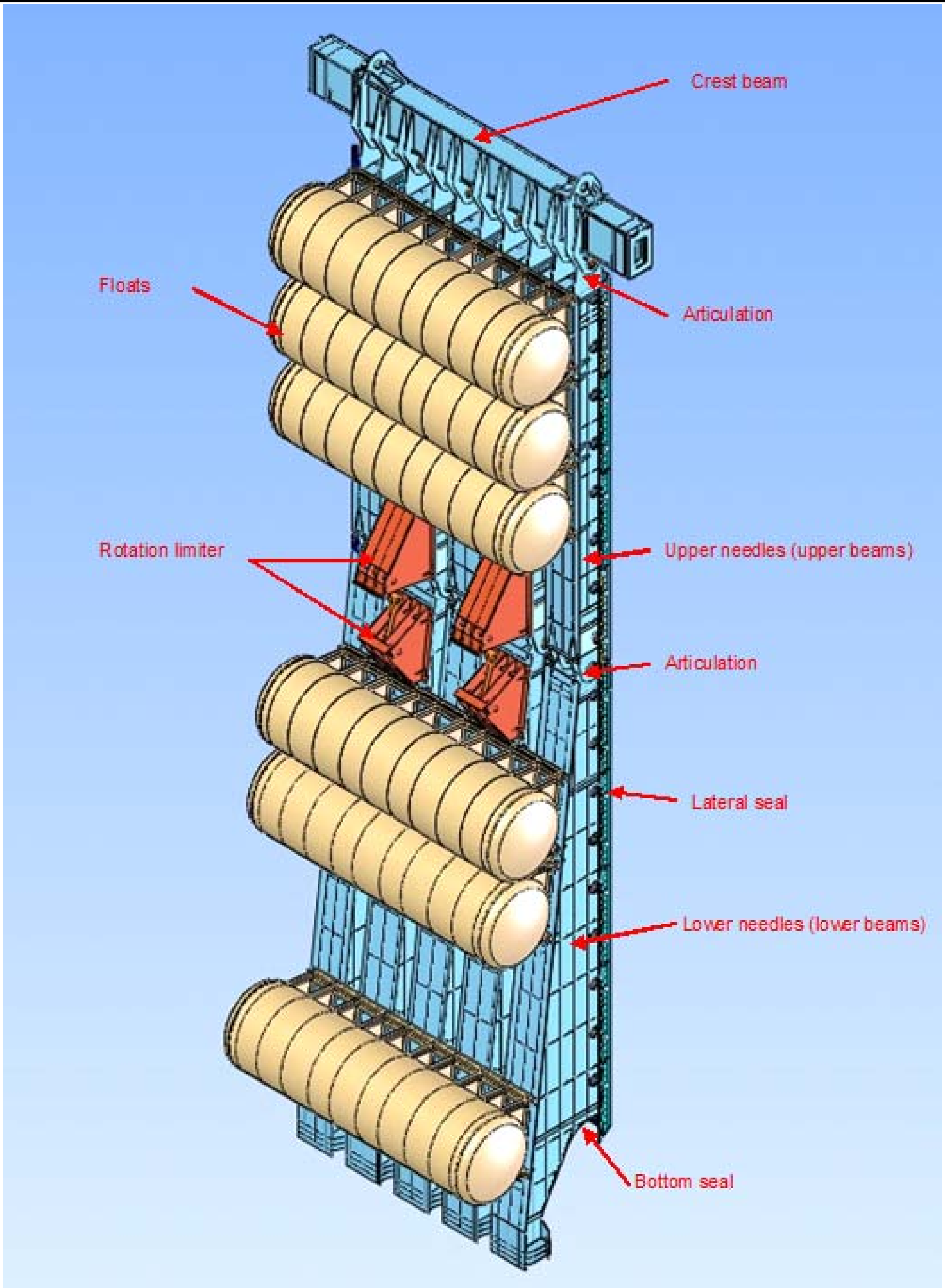
- Installation of a Floating Cofferdam and Rehabilitation of Sluices Gates 1, 3, 4, 5 and 6;
- Upgrading of a Slipway for Assembly of Floating Cofferdam;
- Rehabilitation of Sluice Gate 2;
- Installation of a New Emergency Gate and Gantry

These activities are discussed in further detail in *Section 2.5.1* to *Section 2.5.4* below.

2.5.1 *Installation of a Floating Cofferdam and Rehabilitation of Sluices Gates 1, 3, 4, 5 and 6*

The floating cofferdam will allow for the dewatering and subsequent rehabilitation of sluices one, three, four, five and six, and it will be installed in the front of the upstream face of the spillway. It has a total estimated weight of 540 tons, as well as a height of 39,772 mm, is 14,180 mm in width and a depth of 6,784 mm. The distance between lateral seals is 10,750 mm (*Figure 2.16*).

Figure 2.16 Floating Cofferdam



Source: ZRA, 2014.

Preliminary Preparation Works

Prior to construction and installation of the floating cofferdam, divers will visually inspect the sluices to detect and report on potential defaults on the upstream concrete faces of the spillway. The divers will also carry out underwater grouting (for cracks and construction joints).

Following underwater inspection and grouting; the divers will anchor the steel supports for the cofferdam as follows:

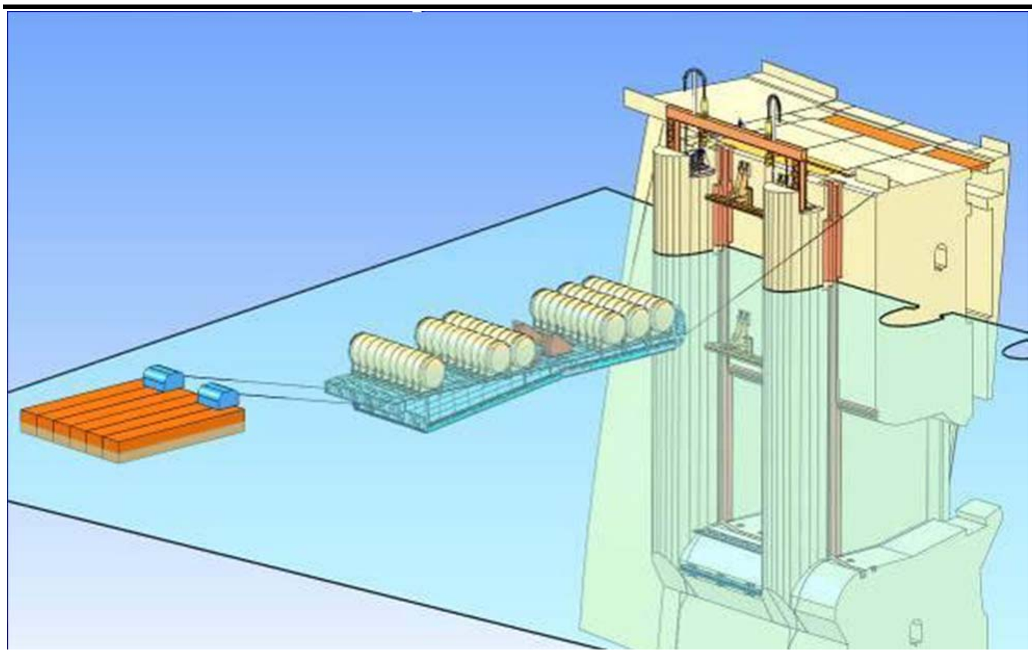
- Surface preparation of anchoring areas by scrubbing, chipping off and pouring mortar between the concrete face and the steel anchor plate.

- The installation of a HB32/HB40 anchorage system, which consists of an injection mortar made of epoxy resin and reinforcement bars. These bars are threaded at their outer end and will contain nuts and washers. The HB32/HB40 anchorage length is around 2 m and is designed for shear and tensile forces.

Assembly and Transport of Cofferdam

The floating cofferdam will have a width of approximately 2.95 m between the skin plate and sealing plane, thus allowing access of workers and equipment/materials. The floating cofferdam will be assembled onshore and transported to the dam in one piece instead of installation in several parts. Following construction of the cofferdam, it will be transported by means of a barge across the reservoir and taken to the dam sluice gates (refer to *Figure 2.17*).

Figure 2.17 ***Floating Cofferdam on way to Sluice Gate***

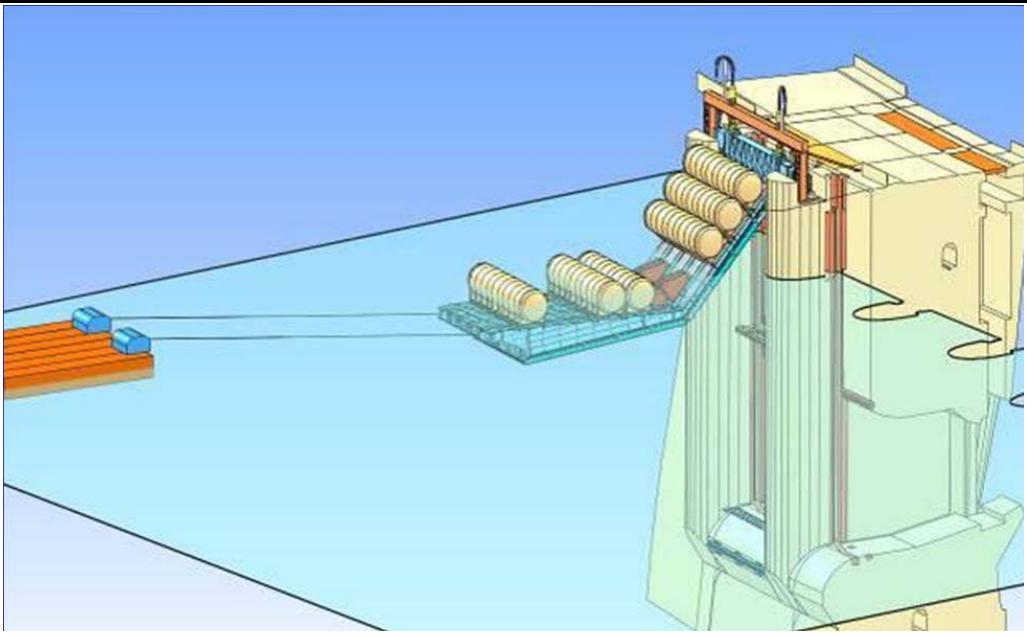


Source: ZRA, 2014.

Installation of Cofferdam onto Sluice

Once the cofferdam has been transported to the spillway, the floating cofferdam is positioned in front of the sluice to be refurbished and positioned by means of hitch lines installed between the floating cofferdam and the crest of the dam (refer to *Figure 2.18*). The crest beam of the floating cofferdam is connected to two lifting strand jacks, and is then lifted to the crest of the dam. During this operation, hitch lines are adjusted to maintain the floating cofferdam in the correct alignment. Once the crest beam has been positioned at the correct level, the cofferdam is secured (refer to positioned cofferdam in *Figure 2.19*).

Figure 2.18 Floating Cofferdam being hoisted onto Sluice Gate



Source: ZRA, 2014.

Ballasting

Once the floating cofferdam has been correctly fitted it is filled with water. This prevents accumulation of pressure and reduces mechanical stress on the structure.

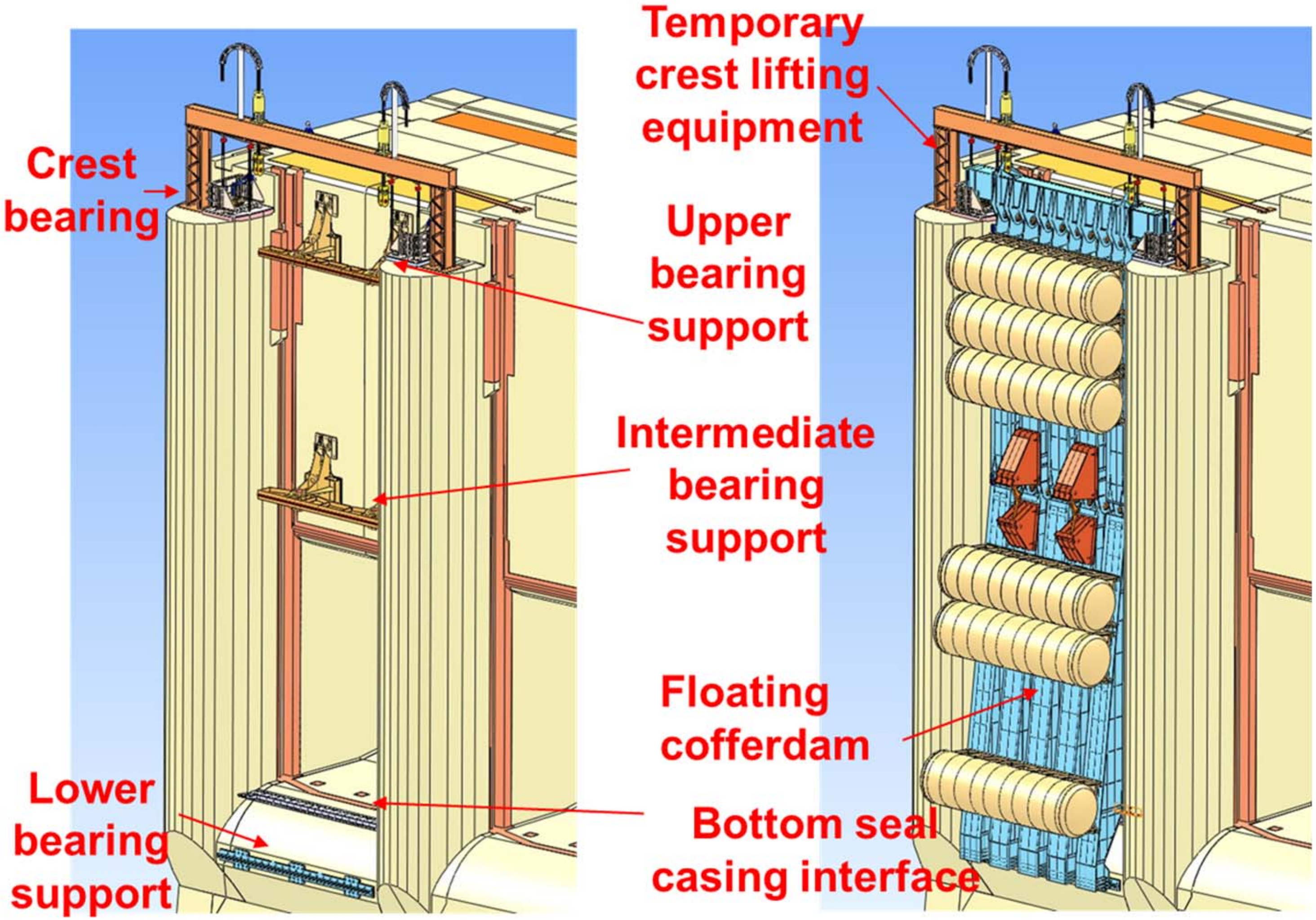
Dewatering of Sluices

The water within the sluice is emptied by slowly opening the floodgate. Once the sluice is totally empty, leaks are located from downstream and blocked from upstream. Following dewatering of the sluices rehabilitation works can commence.

Sluice Rehabilitation and Installation of Stopbeams

Built-in-parts within the sluices need to be replaced and refurbished. The outer layer of concrete will be removed, after which the new stainless steel sills and lintels will be installed, and established with new high strength concrete. Grooves need to be rebuilt to adapt to the new emergency gate. New concrete will be anchored and reinforced on the old concrete to resist the load of new built-in-parts, and control cracking.

Figure 2.19 Floating Cofferdam in Position on a Sluice Gate



Source: ZRA, 2014.

Following rehabilitation of the sluices, new stopbeams will be installed inside the refurbished grooves, upstream of the spillway. The stopbeams weigh approximately 119 tons, and have a height of 14,100 mm, width of 11,330 mm and a depth of 1,710 mm. The installation time is estimated at 19 hours. The stopbeams will be installed in the refurbished grooves by a mobile crane and divers will be required to connect and disconnect the stopbeam to the crane. New stopbeams will enable dewatering of sluices for maintenance works. The stopbeams will be operated individually by means of the new gantry situated at the spillway crest (refer to *Section 2.5.4*).

Withdrawal of Cofferdam

The floating cofferdam is withdrawn in the reverse sequence from its installation. Once the floating cofferdam is back in flotation, it can be stored (in water) and stowed on the bank or it can be installed on another sluice. Anchorages will be cut and supports and bottom seal casing will be removed by divers after temporary cofferdam's removal.

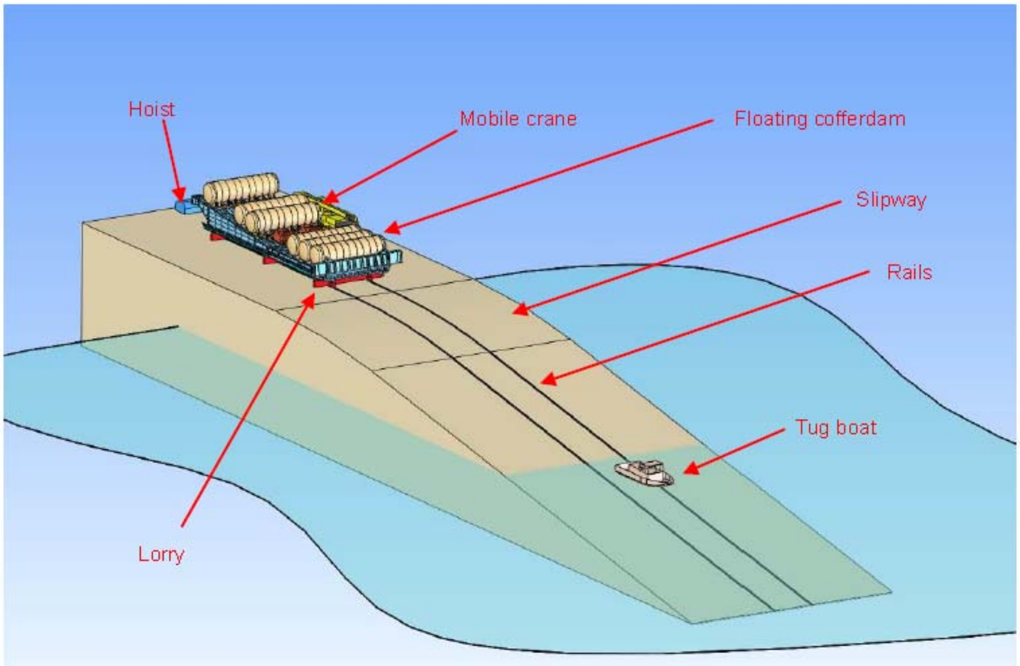
2.5.2 Upgrading of a Slipway for Assembly of Floating Cofferdam

As mentioned in *Section 2.5.1*, the floating cofferdam will need to be constructed onshore and launched into Kariba Lake from a slipway (*Figure 2.20*). The preferred slipway site is located about 2 km south west from the Kariba Dam wall (see *Figure 2.21*). The existing slipway site will need to be upgraded to allow for the assembly of the floating cofferdam and the area will need to be slightly sloped in the lake direction to launch the cofferdam. The slipway is comprised of a hoist, rails and lorries as well as a mobile crane to assemble the floating cofferdam.

The dimensions of the slipway will be as follows –

- 32 m x 50 m assembly area with a slope of 10 degrees.
- Length of the slope will be approximately 138.5 m, to keep a 10 m water depth under minimum lake level.

Figure 2.20 Slipway for Launching the Floating Cofferdam



Source: ZRA, 2014. (Note: depicted tug boat not to scale.)

2.5.3 *Rehabilitation of Sluice Gate 2*

Sluice gate 2 has a different structure to the other sluice gates. The geometry of sluice gate 2 does not allow the floating cofferdam (as is detailed in *Section 2.5.1*) to be used to dewater it. Sluice gate 2 currently has a set of stop beams towards the bottom of the sluice; however, additional stopbeams are needed to fill the height of the trash disposal grooves (refer to *Figure 2.22*). A second set of stopbeams is proposed to be installed. The proposed new stopbeams weigh 254 tons, are 33,400 mm in height, 11,330 mm in width and 1,711 mm in depth. Stopbeams that will be used after refurbishment are fitted with a specific and removable guiding pad structure that can be changed to fit either the existing upstream grooves of sluice gate 2 or to the new refurbished grooves (with a new geometry).

Stopbeams are handled with a mobile crane positioned on the crest of the dam. During installation, divers will monitor all the operations (to ensure smooth running and no jamming). Divers are also used to disconnect the stopbeam from the spreader attached to the mobile crane when the stopbeam has reached its underwater position.

The major difficulty of the works lies in the localization of the existing structural rebars - which should not be damaged.

It must be noted that aggregate material necessary for spillway rehabilitation will be sourced from two existing quarries, namely a ZRA owned quarry and a quarry in Chinhoyi. According to the ZRA this quarry is fully licensed.

Figure 2.21 Location of Preferred Slipway Site

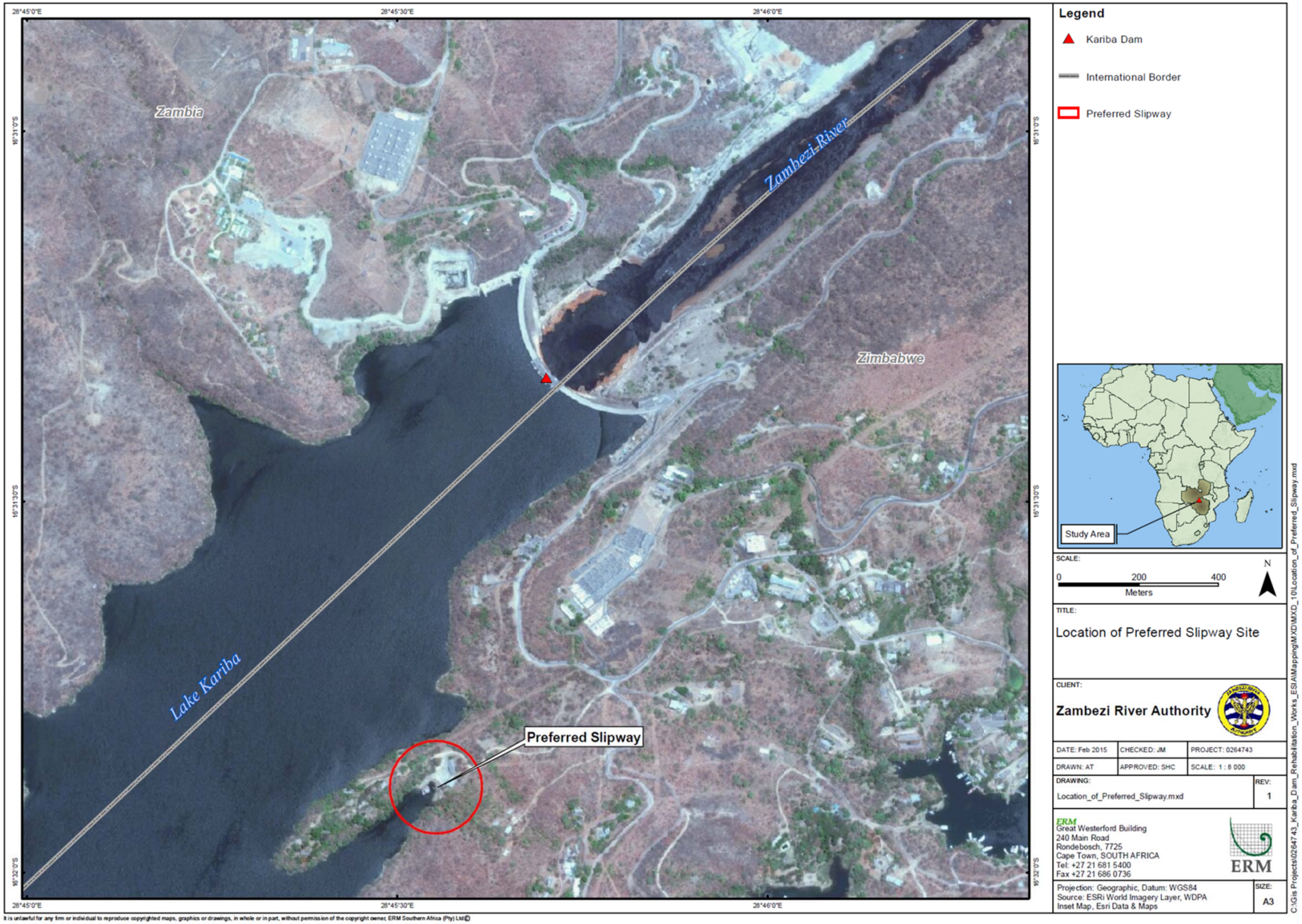
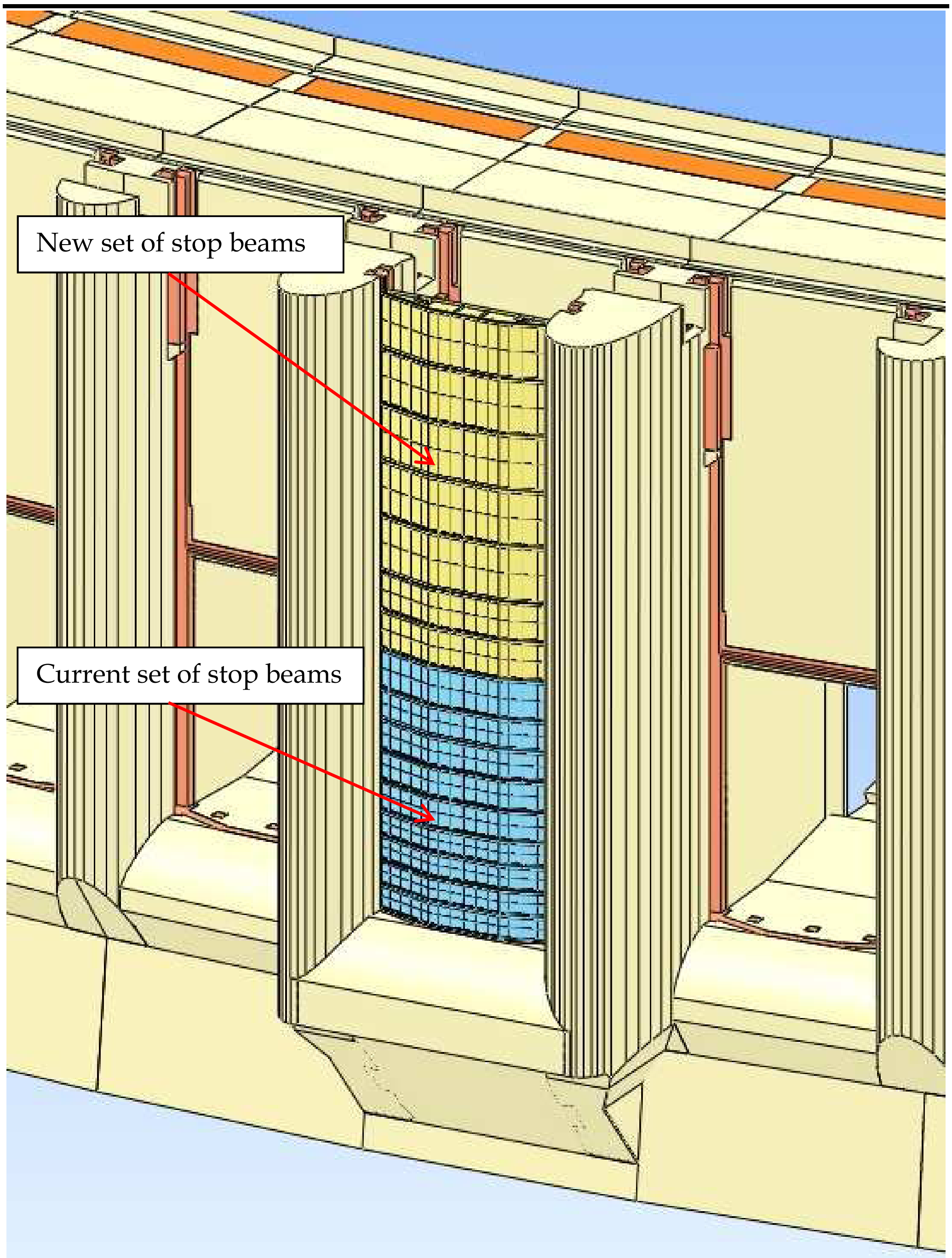


Figure 2.22 Sluice Gate No. 2 Stopbeams



Source: ZRA, 2014.

2.5.4 *Installation of a New Emergency Gate and Gantry*

Emergency Gate

It is proposed that a new emergency gate be installed (refer to *Figure 2.23*).

The new emergency gate provides the following functionalities:

- Closure by simple gravity against full water flow in event of problem with a floodgate (emergency gate function).

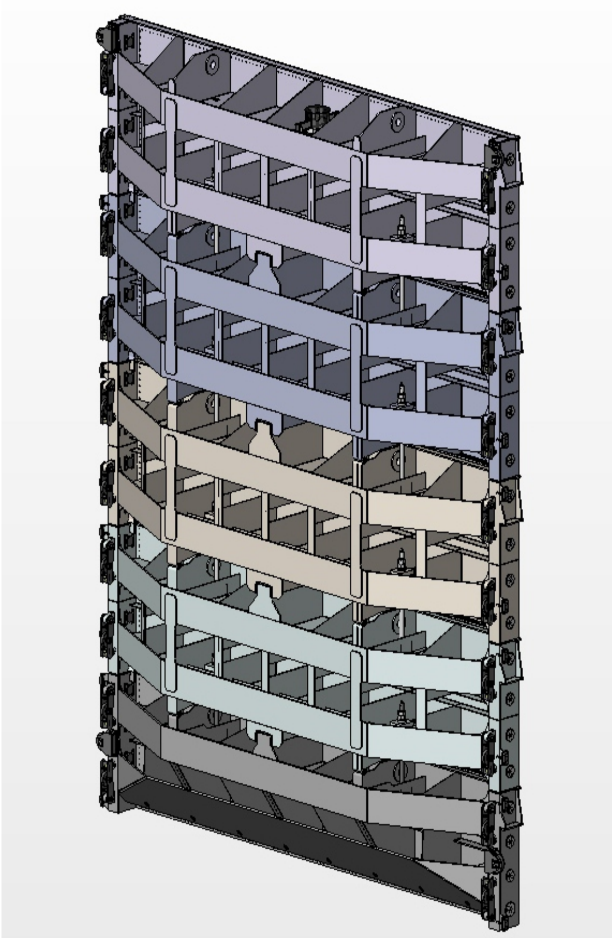
- Dewatering of the sluice in a balanced condition to inspect and work in the floodgate sluice (this function is already available via the existing set of stopbeams).
- Opening of a sluice in a balanced condition under normal operations.
- Opening in flow to control lake level with this sluice should the floodgate be unavailable and in open position (accidental situation).
- It can be stored in close proximity to the dam for immediate use.

The gate will be assembled at the top of the groove and lowered in one block by a new gantry fitted on the crest (see *Figure 2.24*).

The total weight of the emergency gate is 145.8 tons, with a height of 14,125 mm, a width of 11,370 mm and a depth of 1,762 mm. The time required to assemble/disassemble the emergency gate is 30 hours and the time required to lower/lift the gate once assembled is 3 hours.

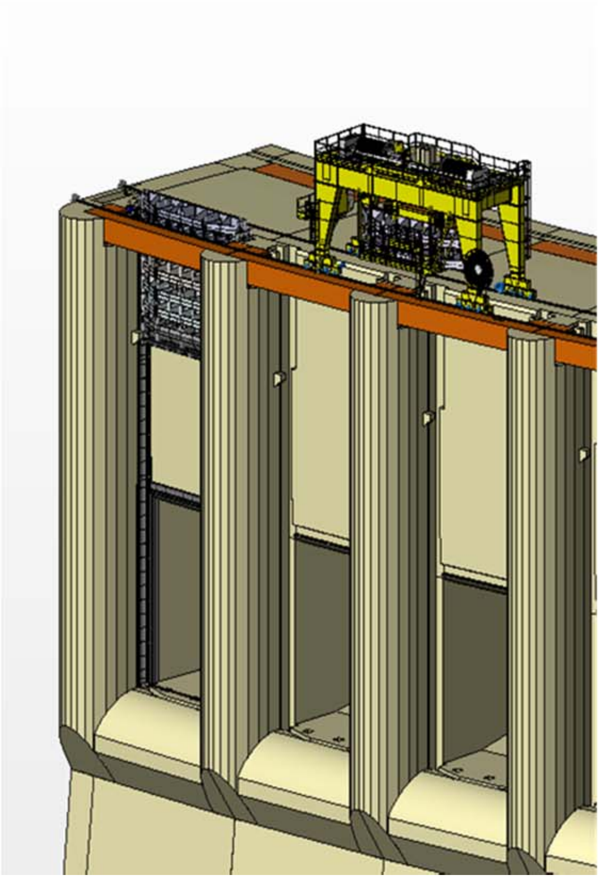
The gate will be designed in as five part fixed-wheel gate with downstream skin plate and can be assembled and disassembled easily.

Figure 2.23 Emergency Gate

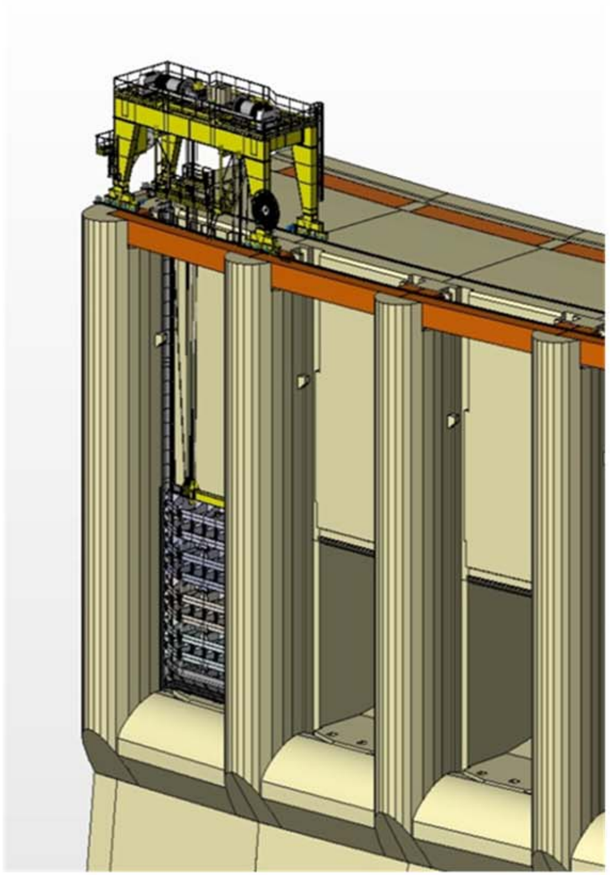


Source: ZRA, 2014.

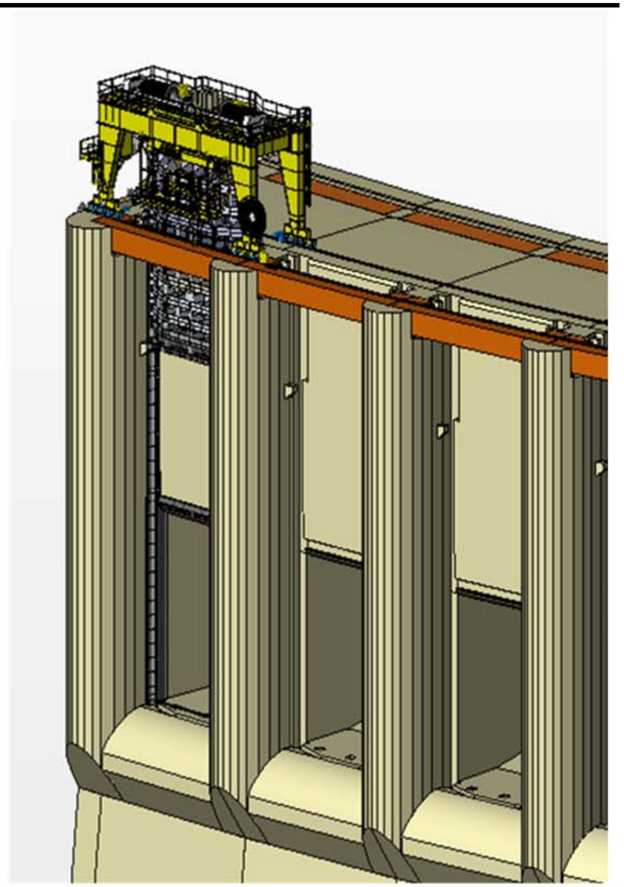
Figure 2.24 Emergency Gate and Gantry Function



Emergency Gate Under Assembly



Emergency Gate Closed



Emergency Gate Opened

Source: ZRA, 2014.

Gantry System

The existing gantry does not have the requisite functionality to serve the refurbished spillway (the lifting capacity is too low) and is proposed to be replaced. The new gantry will be used to:

- Install/remove the emergency gate and stopbeams into/from the sluice gate;
- Transfer stopbeams from their storage position to the sluice gate; and
- Move the emergency gate elements between sluice gates during assembly.

The new gantry will have a weight of 165 tons, with a normal lifting capacity of 400 tons, an accidental lifting capacity of 740 tons and a total lifting stroke of approximately 38,000 mm.

2.5.5 Provisional Work Schedule

It is assumed that works associated with rehabilitation of the spillway will take 8 years to complete.

The refurbishment of one sluice gate would take one year, from the installation of the temporary cofferdam to its removal. The commissioning order would follow the refurbishment order for sluices number six to four, commissioning taking place within the two years following sluice's refurbishment.

2.5.6 Cost Estimate

The estimated costs for the spillway rehabilitation are presented in *Table 2.2.*

Table 2.2 Estimated Spillway Rehabilitation Costs

Activity	ANNUAL BUDGET ('000 US$)									Amount (US$)
	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Tendering	377									377
Floating Cofferdam		35,000	13,200							48,200
Sluice n°2 specific cofferdam		11,620								11,620
Emergency gate		4,500	1,230							5,730
Gantry Runway		2,866								2,866
Gantry		3,500	3,286							6,786
New stopbeams		2,865								2,865
Slipway-drydock preparation		2,500	7,454							9,954
(S6)Sluice 6 Refurbishment			5,550							5,550
(S5)Sluice 5 Refurbishment				5,550						5,550

Activity	ANNUAL BUDGET ('000 US$)									Amount (US$)
	2014	2015	2016	2017	2018	2019	2020	2021	2022	
(S4)Sluice 4 Refurbishment					5,550					5,550
(S3)Sluice 3 Refurbishment						5,550				5,550
(S1)Sluice 1 Refurbishment							5,550			5,550
(S2)Sluice 2 Refurbishment								5,550		5,550
Gantry installation						9,600				9,600
Emergency gate installation						5,700				5,700
New stopbeams supply						2,860				2,860
Commission of the new system									150	150
TOTAL BUDGET FOR SPILLWAY REFURBISHMENT	**377**	**62,851**	**30,720**	**5,550**	**5,550**	**23,710**	**5,550**	**5,550**	**150**	**140,008**

Source: ZRA, 2014

Failure to implement remedial measures to the plunge pool will result in the failure to operate the reservoir as expected (i.e. at a reduced capacity) or required under extreme flood events, and an increase in the risk of dam wall failure. A scenario where the dam wall fails will release a flood event of a total 273 km^3 resulting in:

- Major loss of life as the flood plain is home to approximately three million people;
- Loss of livelihoods (socio-economic activities);
- Environmental degradation; and
- A loss of main source of power to the SADC region.

Catastrophic dam failure of the Kariba Dam would result in significant downstream environmental damage reaching into the Mozambique delta. However, arguably the most important motivating factor of the proposed Kariba Dam Rehabilitation Works is the potential resultant human fatality risks that would result from a catastrophic dam failure event. There are an estimated three million people who live downstream of the Kariba Dam that may be impacted should the dam fail. Therefore, it is imperative that the Kariba Dam is maintained in safe working condition.

Moreover, the Kariba Dam Hydro-Electric Scheme significantly contributes to the security of energy supply to the SADC region and specifically to Zambia and Zimbabwe over the last 50 years. This region has an increasing demand for energy supply, placing even greater significance to the existing energy supply by the Kariba Dam Hydro-Electric Scheme. Loss of this supply as a result of dam failure would significantly adversely impact the socio-economic status of the region.

Therefore, timely rehabilitation is required in order to prevent further degradation of dam safety features, and to uphold Kariba Dam's status of functioning to meet international standards.

4 LEGAL AND ADMINISTRATIVE FRAMEWORK

This *Chapter* sets out the relevant legal and policy context applicable to the Project in Zambia and Zimbabwe. Specifically, this chapter summarises the following:

- The relevant institutional framework in Zambia and Zimbabwe involved in the regulation of this Project;
- Relevant Zambian and Zimbabwean environmental and social laws and Regulations which are applicable to the Project;
- International treaties, conventions and protocols relevant to the Project and to which Zambia and/ or Zimbabwe is a signatory;
- Environmental and social guidelines and standards developed by the Southern African Power Pool (SAPP), and international organisations such as the International Finance Corporation (IFC) and the World Bank, with which the Project will need to align; and
- Other international guidelines and standards directly applicable to dam-building and hydropower projects which are considered international good practice.

4.1 ZAMBIA

4.1.1 *Zambian Institutional and Organisational Framework*

National Policy on Environment (November 2007)

The Government of the Republic of Zambia has developed a National Policy on Environment to avoid conflict of interest, harmonise sectorial strategies, and rationalise legislation that concerns the use and management of environment. The purpose of this policy is to attain an integrated approach to development through a national cross-cutting consensus. This Policy was developed through a research and consultative process and will be fully integrated in principles of decentralisation, community participation and privatisation that underpin sustainable development.

Applicability to Project

Section 7.1.4.2 of the Policy states that EIAs are (where deemed necessary) required to ensure that public and private secotr development options are environmentally sound and sustainable and that any environmental consequences are recognised early and taken into account in project design and implementation.

In this respect, and to fulfil the requirements of the Policy, the ZRA has contracted ERM to carry out a detailed ESIA for the proposed Project. The ESIA has been carried out in conformance to both the Zambian and Zimbabwean environmental legislation and other international requirements.

Ministry of Lands, Natural Resources and Environmental Protection

The Ministry of Lands, Natural Resources and Environmental Protection is charged with the critical responsibility of land administration, natural resource management and environmental protection on behalf of the people of Zambia.

The following Departments fall under this Ministry:

- Human Resource and Administration;
- Lands and Deeds;
- Lands Department;
- Survey Department;
- Forestry Department; and
- Environment and Natural Resources Management Department (ENRMD).

Environment and Natural Resources Management Department

The Environment and Natural Resources Management Department (ENRMD) was established by presidential declaration which merged the then Ministry of Tourism (MOT) and the Ministry of Environment and Natural Resources (MENR) in 2002. It became operational in February 2003 but was not established by an Act of Parliament.

The ENRMD is responsible for the overall policy formulation on environment, natural resources and pollution control in the Ministry which is the focal point for all environmental and natural resource management issues in the country. The department also co-ordinates, monitors and evaluates the operations of the executive agencies that have been created to implement policies on behalf of the government [(1)].

The Department of Environment and Natural Resources Management focuses on the achievement of the following six objectives as they relate to issues of

(1) http://www.ministryoflands.gov.zm/index.php/natural-resources-and-environment

the environment and natural resources as outlined in the Strategic Plan (2002 – 2006), which is currently under review):

- To facilitate and promote research and development in environment, wildlife, forestry and cultural heritage in order to increase knowledge and its utilisation;

- To facilitate and monitor the implementation of international agreements and treaties in environment and natural resources in order to promote Zambia's interests and meet international obligations;

- To promote investment in environment and natural resources in order to contribute to employment creation, poverty alleviation and supply of raw materials;

- To facilitate the quality provision of education and training in environment and natural resources in order to contribute to their effective management, sustainable development and utilisation;

- To undertake and facilitate rehabilitation of degraded habitats in order to restore the productivity of Zambian flora and fauna; and

- To promote the effective management of forest, wildlife and heritage resources in order to ensure their sustainable utilisation and contribute to the alleviation of rural poverty.

Applicability to Project

The Zambia Environmental Management Agency (ZEMA) falls under the ENRMD. Accordingly, the ENRMD co-ordinates, monitors and evaluates the operations of the ZEMA and is mandated to ensure that the proposed Project is undertaken in a way that it complements the six objectives related to issues of the environment and natural resources as outlined in the Strategic Plan (2002 – 2006).

The Zambia Environmental Management Agency

The Zambia Environmental Management Agency (ZEMA), previously known the Environmental Council of Zambia (ECZ) (1) is the umbrella environmental institution in Zambia and the main lead agency on matters pertaining to environmental impact assessments (EIA). It is empowered by the Environmental Management Act (No. 12 of 2011) to identify projects, plans and policies for which an EIA is necessary.

(1) The Environmental Council of Zambia (ECZ) is a department within the Ministry of Lands, Natural Resources and Environmental Protection created under an Act of Parliament, the Environmental Protection and Pollution Control Act (EPPCA) of 1990, Cap 204 of the Laws of Zambia. The EPPCA has since been repealed and replaced by the Environmental Management Act (No. 12 of 2011) (EMA). Under the EMA, the ECZ has been renamed as the Zambian Environmental Management Agency (ZEMA).

The general functions of the ZEMA are to ensure the sustainable management of natural resources, the protection of the environment, and the control of pollution, as provided under Section 9(1) of the Environmental Management Act. However, more specifically, the ZEMA serves *inter alia* to:

- Co-ordinate the implementation of activities of all government ministries, appropriate authorities and conservancy authorities in matters relating to the environment;

- Develop standards and guidelines relating to the protection of air, water, land and other natural resources;

- Provide for environmental monitoring and auditing as well as establishing and managing of the environmental fund;

- Develop and enforce measures aimed at preventing and controlling pollution;

- Advise the government on the formulation of policies on all aspects of the environment and make recommendations for the sustainable management of the environment;

- Advise on all matters relating to environmental conservation, protection and pollution control, including necessary policies, research, investigations and training;

- Initiate, conduct and promote research, surveys, studies, training and investigations in the interests of environmental management;

- Identify projects, plans and policies that need environmental impact assessments;

- Monitor trends with respect to natural resources, their use and impact on the environment and make necessary recommendations to the appropriate authority;

- Undertake general education programmes for the purpose of creating public awareness of the environment;

- Provide for public consultation in environmental decision – making and access to environmental information;

- Request information on proposed projects and advise stakeholders on projects, programmes, plans and policies for which environmental assessment is necessary; and

- Facilitate the implementation of international environmental agreements and conventions to which Zambia is a party.

The services provided by the ZEMA specifically in relation to EIA studies include:

- Assisting the developer to determine the scope of EIA studies;
- Reviewing project briefs, terms of reference, and environmental impact statements (EIS) and decision-making;
- Disclosure of the EIS to the public through the media;
- Holding public hearing meetings to discuss the EIS with stakeholders;
- Conducting verification surveys of the affected environment;
- Monitoring the project once implemented;
- Conducting compliance audits of the project between 12 and 36 months after implementation; and
- General administration of all the Regulations under the Environmental Management Act.

ZEMA has a number of units which control various aspects of environmental pollution planning and environmental management. These have been organised under two departments:

- **The Pollution Control Inspectorate**, which is responsible for all pollution and regulation issues pertaining to waste, emissions and toxic substances. This inspectorate also has a dedicated unit responsible for EIAs.
- **The Planning and Information Management Department**, which comprises units in charge of planning, monitoring, education, communication, information, documentation and data management.

Applicability to the Project

The Zambezi River Authority (ZRA) has decided in order to be aligned with international good practice and standards to undertake an EIA for the Kariba Rehabilitation Works Project and to have this EIA submitted to ZEMA for approval.

Ministry of Tourism and Arts

The Ministry of Tourism and Arts was created on 10th July, 2011 after realignment of Government Ministries by His Excellency the late Mr. Michael Chilufya Sata, the President of Republic of Zambia. This brought together the portfolio functions of tourism from former Ministry of Foreign Affairs and Tourism and the portfolio functions of Culture from the Ministry of Chiefs and Traditional Affairs. This was done in order to streamline and rationalise the functions and operations of the tourism and cultural sector.

Applicability to the Project

The Kariba Dam is a key tourism area and international visitors are attracted to the water body and the surrounding rural/natural environment for a variety of activities, including - safaris, boating, fishing, sunset cruises, canoeing, water sports, bird watching, cultural village tours and visiting look-out points.

Accordingly, the Ministry of Tourism and Arts is regarded as a key stakeholder and will be consulted with as part of the ESIA process.

The Zambia Wildlife Authority

The Zambia Wildlife Authority (ZAWA) is a corporate body established by the Zambia Wildlife Act of 1998.

The primary objectives of ZAWA are:

- To improve the quality of life amongst communities in wildlife estates and the maintenance of sustainable biodiversity in national parks and game management areas;
- To reverse the decline in wildlife resources;
- To improve wildlife resource management to a level which will secure a sustainable flow of benefits from such wildlife resources; and
- To considerably improve the wildlife resource base investment in co-operation with the private sector and local communities.

Applicability to the Project

The proposed Project is situated in an area that may inhabit faunal species and flora species of concern. Furthermore, the areas downstream of the dam up to the Mozambique border consist of National Parks and extensive transfrontier conservation areas.

Accordingly, the Zambian Wildlife Authority is regarded as a key stakeholder and will be consulted with as part of the ESIA process.

The National Heritage Conservation Commission

The National Heritage Conservation Commission (NHCC), formally known as the Commission for the Preservation of Natural and Historical Monuments and relics (National Monuments Commission), is the national institution mandated to manage and conserve Zambia's cultural and natural heritage resources, including significant:

- Historic/architectural/buildings;
- Historic sites;
- Anthropological sites;
- Archaeological sites;
- Geomorphological sites;
- Geophysical sites;
- Paleontological sites; and
- Ecological and other sites.

The National Museum Board

The National Museum Board of Zambia (NMB) is a corporate body which has the principal role of preserving the nation's history and movable heritage. The Board is mandated to collect, document, present to the public and to preserve for posterity Zambia's movable heritage.

Applicability to the Project

Although it is not anticipated that there are any cultural heritage sites located in the Project Area, there may be sub-surface archaeological resources that could fall within the footprints of proposed ground disturbing activities. Accordingly, the National Museum Board is considered a Key Stakeholder in the ESIA process.

Ministry of Mines, Energy and Water Development

The Ministry of Energy and Water Development (MEWD) has been merged with the Ministry of Mines to form a new Ministry of Mines, Energy and Water Development. The Ministry comprises six Departments. The functions of the Departments relevant to the Project are described below.

The functions of the Department of Energy (DoE) are:

- To develop, articulate and implement a Policy on Energy;
- To formulate programmes for the development of the energy sector;
- To ensure that there are efficient and reliable supplies of energy for socio-economic development;

- To integrate the energy sector into Zambia's national and regional development strategies; and
- To regulate the energy sector through appropriate legislation including the development of new laws and by-laws.

The functions of the Department of Water Affairs (DWA) include the following:

- To oversee and control activities of water resource development and management in order to prevent the indiscriminate consumption of water resources;
- The provision of sufficient and reliable data on water resources availability and demand in the country, to allow for effective planning;
- Utilisation and management of water resources; and
- The development and management of water conservation.

The DWA is comprised of a Groundwater Resources Section, a Surface Water Resources Section and a Water Resources Management Section. The Surface Water Resources Section and the Water Resources Management Section will have an interest in how the Project will affect surface water flows in the Zambezi River and the effects on current water resource use in the area. These governmental institutions will govern to what extent the current water use system can be altered.

In addition to these two departments, the MEWD supervises the following statutory/parastatal bodies:

- The Energy Regulation Board (ERB);
- ZESCO Ltd;
- The Water Resources Management Authority; and
- The Office for Promoting Private Power Investment (OPPPI).

The Energy Regulation Board

The Energy Regulation Board (ERB) has the mandate of regulating the energy sector in line with the provisions of the Energy Regulation Act of 2003. The ERB has the responsibility of ensuring that power generating utilities earn a reasonable rate of return on their investments that is necessary to provide a quality service at affordable prices to the consumer.

In order to carry out this role, the ERB, among other functions, ensures that all energy utilities in the sector are licensed, monitors levels and structures of competition, and investigates and remedies consumer complaints.

ZESCO Limited

ZESCO Limited is a parastatal, with the main function of producing power in Zambia. ZESCO produces approximately 80 % of the electricity consumed in the country and has historically been the main player in the generation, transmission and distribution of electricity in Zambia. In addition, ZESCO represents Zambia in the Southern African Power Pool. Due to the ever increasing demand for electricity both in Zambia and in the region, ZESCO is currently being forced to source more electricity from independent power producers (IPPs) such as Lunsemfwa Hydro Power Company (LHPC).

Applicability to the Project

The Kariba contains two separate hydropower plants: one on the Zambian side and one on the Zimbabwean side of the Zambezi River. As the proposed Project (and in particular the excavation works in the plunge pool) has the potential to impact on the two hydropower plants, the Ministry of Energy and Water Development (MEWD) and associated Energy Regulation Board (ERB) and ZESCO Limited are considered as Key Stakeholders in the ESIA process.

Water Resources Management Authority

Due to the increase in population, the demand for water for power generation, direct consumption and other uses of water has increased in Zambia. As such, the Water Resources Management Authority was developed in response to these often conflicting demands for water. The Water Resources Management Authority is essentially an executive wing of government which provides necessary information for the control of abstractions from water bodies in Zambia. Any person who wishes to store or divert water from public streams and waterways for primary, secondary, or tertiary use must obtain permission from the Water Resources Management Authority.

Applicability to the Project

The proposed Project has the potential to impact on the hydrology and water quality of the Zambezi River downstream of the excavation works associated with rehabilitation of the plunge pool. Accordingly, the Zambian Water Resources Management Authority are considered as Key Stakeholders in the ESIA process.

Other Line Ministries

Environmental and social issues cut across a wide variety of sectors and there are a number of government institutions and agencies which are involved in environmental and social management. Some of the ministries, sectorial agencies and authorities that may also need to be consulted as part of the Project:

- Ministry of Agriculture and Livestock;

- Ministry of Health;
- Ministry of Education, Science and Vocational Training; and
- Ministry of Local Government and Housing.

Applicability to the Project
The proposed Project has the potential to impact on the receiving socio-economic environment. Accordingly, these other line Ministries are considered as Key Stakeholders in the ESIA process.

The relevant institutions have been consulted with as part of the stakeholder engagement process, as described in *Chapter 6*.

4.1.2 *Zambian Environmental and Social Laws and Regulations*

The Zambian Environmental Management Act

The Zambian Environmental Management Act (EMA) (Act 12 of 2011) is the principal law on integrated environmental management in Zambia. The Zambian EMA was enacted in April 2011 to repeal and replace the Environmental Protection and Pollution Control Act (EPCCA) (CAP 204) and its Amendments.

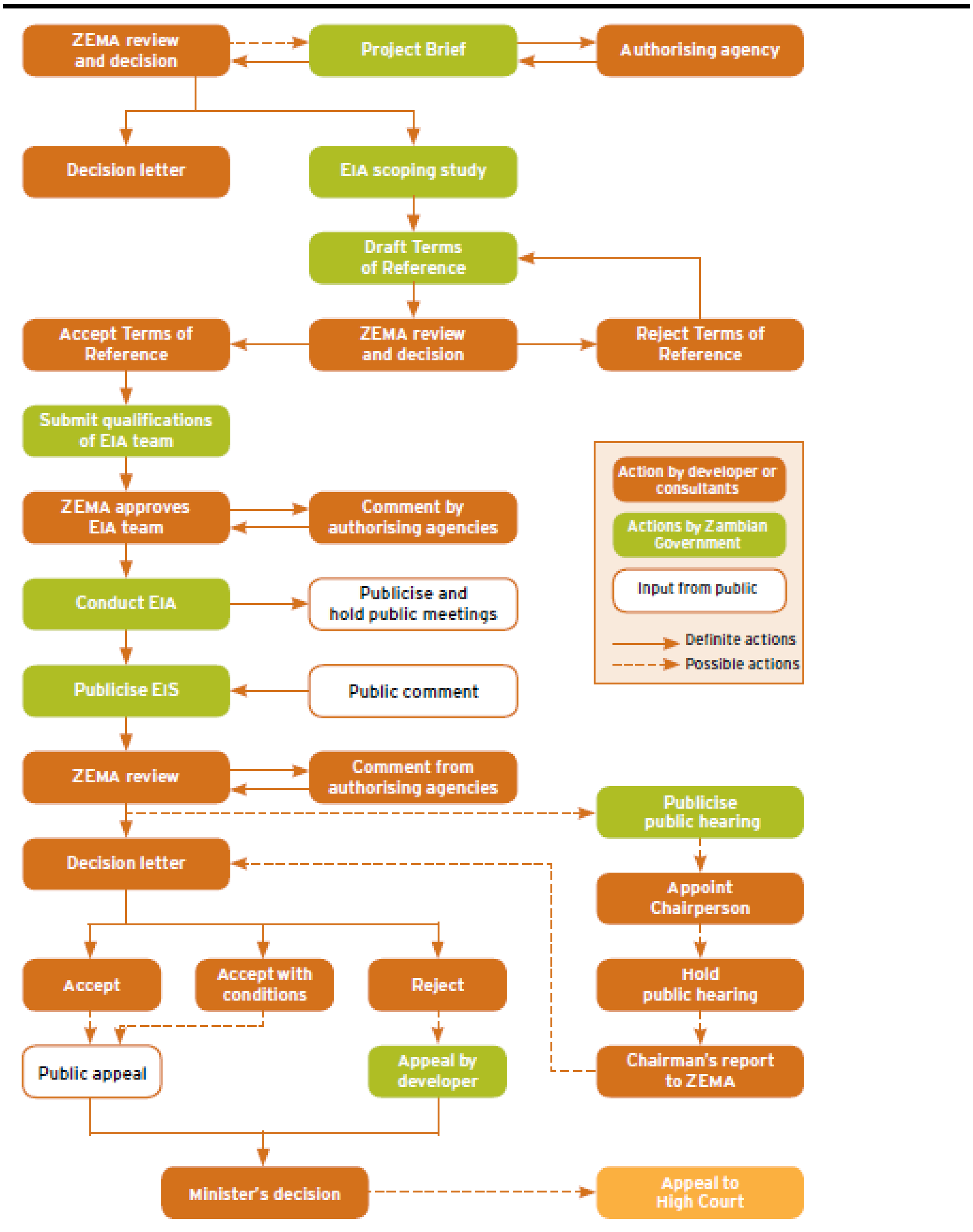
Applicability to Project
Section 4 mentions that every person living in Zambia has the right to a clean, safe and healthy environment and should a person is threatened or is likely to be threatened as a result of an act or omission of any other person, bring an action against the person whose act or omission is likely to cause harm to human health or the environment. Moreover, Section 5 states that every person has a duty to safeguard and enhance the environment. Part IV (Division 1) contains provisions for pollution control including protection of the atmosphere (Section 31), environmental emergency preparedness (Section 41) and regulations around pollution control (Section 43). Division 2, Sections 45 to 48 of the Act make considerations for water resources. More specifically, Section 46 states that a person shall not discharge or apply any poisonous, toxic, eco-toxic, obnoxious or obstructing matter, radiation or other pollutant, or permit any person to dump or discharge such matter or pollutant into the aquatic environment in contravention of water pollution control standards. Section 52 of Division 3 (Part IV) of the Act states that ambient air quality standards and guidelines shall be established under this Division and published. Section 68 of Division 6 (Part IV) of the Act states that person shall not emit noise in excess of the noise emission standards established. Section 77 (2) of Division 8 of the Act states that no person shall place any invasive alien species into any element or segment of the environment. Moreover, Section 78 states that an occupier of any land shall take such measures as are prescribed and are reasonably necessary for the eradication or prevention of the spread of invasive alien species. This ESIA and associated ESMP have considered these provisions.

Environmental Impact Assessment Regulations

The Environmental Impact Assessment (EIA) Regulations, which provide the framework for conducting and reviewing environmental impact assessments for any project, fall under the EPPCA (Statutory Instruments No. 28 of 1997). The Regulations enacted under the EPPCA are still in force until the Minister enacts new Regulations under the Zambian EMA (Act, No 12 of 2011).

The EIA process to be undertaken for this Project is illustrated in *Figure 4.1* below.

Figure 4.1 Zambian ESIA Process



Source: SADC Environmental Legislation Handbook 2012

Applicability to Project

The ZRA have contracted ERM to undertake an independent Environmental and Social Impact Assessment (ESIA) Process. The ESIA process compliments and fulfils the requirements of Zambian EIA regulations.

The Environmental Management (Licensing) Regulations, S.I. No. 112 of 2013

The Environmental Management (Licensing) Regulations were published under the Zambian EMA and provide for licensing requirements pertaining to specific subject areas, including:

- Air and water pollution;
- Waste management;
- Hazardous waste;
- Pesticides and toxic substances; and
- Ozone depleting substances.

The Environmental Management (Licensing) Regulations have provided for the repeal of the following legislation:

- The Waste Management (Licensing of Transporters of Wastes and Waste Disposal Sites) Regulations, S.I. No. 71 of 1993;

- The Water Pollution Control (Effluent and Waste Water) Regulations, S.I. No. 72 of 1993;

- The Pesticides and Toxic Substances Regulations, S.I. No. 20 of 1994;

- The Air Pollution Control (Licensing and Emission Standards) Regulations, S.I. No. 141 of 1996;

- The Environmental protection and Control (Ozone Depleting Substances) Regulations, S.I. No. 27 of 2001; and

- The Hazardous Waste Management Regulations, S.I. No. 125 of 2001.

The Regulations were published under the Zambian EMA and provide for licensing and management requirements for –

- **Air Pollution Monitoring Permits** – under the Air Pollution Control (Licensing and Emission Standards) Regulations, 1996

- **Water Effluent Discharge Permits** – under the Water Pollution Control (Effluent and Wastewater) Regulations, 1993

- **Waste Management Licenses** – under the Waste Management (Transporters of Waste/Operation of Waste Disposal Sites) Regulations, 1993 Hazardous Waste Management Regulations, 2001

- **Pesticides and Toxic Substances Licences** – under the Pesticides and Toxic Substances Regulations, 1994

Applicability to Project

The applicability of these specific permits/licenses will need to be considered as Part of final Project Design.

Other Relevant Environmental and Social Legislation in Zambia

Environmental issues cut across a wide variety of sectors, as such there are numerous pieces of legislation in Zambia which have a bearing on the environment and should be considered during ESIA decision-making.

Table 4.1 presents a summary of Zambian national legislation.

PLEASE NOTE:

Table 4.1 does not provide a detailed description for all legislative instruments; rather, the legislative instruments deemed applicable for the proposed Kariba Dam Rehabilitation Project and the associated Environmental and Social Management thereof have been elaborated on in terms of their applicability to the proposed Project.

Table 4.1 Summary of Relevant Zambian Environmental and Social Legislation

Component	Applicable Legislative Instrument	Description of Legislative Instrument
		Natural Resources and Heritage
Water Resources	• *Water Resources Management Act, No 21 of 2011*	*Part V (Water Quantity and Quality Management), Section 46 mentions that discharge into a water resource shall be done in accordance with the Environmental Management Act, 2011.* *According to Section 71 (activities where water permits may be required), a person who intends to carry out activities identified in this Section shall apply for a permit and pay such charges, for the use of the water, as may be prescribed. It is the understanding of this process that a water permit will not be necessary for this Project.* *In accordance to Section 149 (Part XIV), all significant spills to a water course must be reported to the police, appropriate authorities (including conservation authorities), catchment council and local authority.* *Such management measures have been considered in this ESIA and associated ESMP, particularly to the Zambezi River downstream of Kariba Dam.*
Wildlife and Natural Resources	• *Zambia Wildlife Act, No. 12 of 1998*	*Part VI (Game Animals and protected Animals) includes provisions for game and protected animals. More specifically Section 31 of Part VI states that any person who hunts any game or protected animal, except under or in accordance with the conditions of a valid license issued under Part VII of this Act, shall be guilty of an offence. This is further reiterated in Section 67 of the Act. Notwithstanding anything of the contrary of the Act, Section 78 of Part IX states that a person may kill any wild animal in defence of himself or in defence of any other person if it is necessary – provided that nothing in the Act shall exonerate any person, who at the time of killing any wild animal in self-defence or in defence of any other person, was committing an offence under the Act. Should such a kill take place, the person who killed the animal shall, within a period of forty eight hours, make a report of the facts to the nearest proper officer. In accordance with Section 80 of the Act, any person who kills any game animal or protected species through accident or error shall within a period of fourteen days make a report of the act to nearest proper officer.* *As the Kariba Dam Rehabilitation Project will be in relatively close proximity to Protected Areas, management/mitigation commitments for the protection of terrestrial fauna will need to be considered in the ESIA and associated ESMP.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
Fisheries and Wetlands	• *National Policy on Wetlands Conservation, September 2001*	*This Policy was formulated in response to the fragmented sectoral policies and Acts. It aims to provide a holistic programme of action to promote the conservation and wise use of wetland ecosystems. It acknowledges the importance of wetland ecosystems in Zambia in providing major fisheries and as important habitats for various wildlife species.* *The management of surface water quality, aquatic environments (including aquatic vegetation) and terrestrial ecology (including fauna utilising wetland habits) is provided in the ESMP. This ESIA has considered the provisions of this National Policy.*
Noise & Vibration	• *Part IV of EMA,No.12 of 2011*	*Section 68 of Division 6 (Part IV) of the Act states that person shall not emit noise in excess of the noise emission standards established.*
Explosives	• *Explosives Act (No 10 of 1974) Regulations are in draft stage.*	*Section 3 of the Act states that the Act shall apply (amongst others) to the, storage, use, possession and transportation of explosives.* *Part I of the Act provides general measures for the storage, handling and use of explosives. Part III includes provisions for the transportation of explosives by waterway, road, rail or air; and Part IV includes provisions for the transportation of explosives around the work site. Part V includes provisions for the storage of explosives at the work site and Part VIII includes requirements for the use of explosives.* *Blasting management measures are provided for in the ESMP. The development of these measures and detailed design around blasting management for the Kariba Dam Rehabilitation Project has and will take these requirements into consideration.*
	Energy	
Energy	• *Energy Regulation Act, Cap 436, 1995*	*Provides for the control in the pricing of energy products in the country as well as the quality.*
	• *The Petroleum Act, (No. 8 of 1995)*	*The areas of the Petroleum Act of relevance to this project are regulations for the conveyance and storage of petroleum, inflammable oil and liquids.*
	• *The Electricity Act, 1995*	*Regulate the transmission, distribution and supply of electricity.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
Socioeconomic, Archeology and Cultural Heritage		
Health	• *Factories Act (Chapter 441 of the Laws of Zambia) (as amended by Statutory Instrument (S.I.) No. 165 of 1989, No. 75 of 1990, and Act No. 13 of 1994).*	*The Factories Act is intended to make further and improved provision for the regulation of the conditions of employment and regards the safety, health and welfare of persons employed therein.* *Part V (Health: General Provisions) of the Act includes provisions around cleanliness, overcrowding, ventilation, lighting and sanitary requirements for employees and Part VI (Safety: General Provisions) includes provisions for the use of machinery, training, facilities, precautions for the use of explosives, emergency drill training requirements for employees.* *Moreover, Part IX includes provisions for the welfare of employees, including provisions for drinking water, washing facilities, accommodation and change rooms, first aid and resting facilities. Section 71 of Part X includes requirements for provision of Personal Protective Equipment (PPE) and additional health and safety and welfare measures.* *The ESIA and associated ESMP has considered and made provision for worker health and safety. Moreover, the ESIA has considered the provisions included in this Act.*
Archaeological, Historical and Cultural	• *National Heritage and Conservation Act, 1989*	*Part V of this Act (Conservation of Heritage) states that (Section 35) any person who wishes to destroy, demolish, alter or remove from its original site any monument, relic or ancient heritage shall apply for permission to the Commission. Moreover, Section 37 states that any person who desires to excavate any ancient heritage or collect relics shall apply to the Commission for permission.* *In accordance with Section 42, any person who discovers a potential ancient heritage or relic shall report the find to the commissions and suspend operations in the immediate vicinity to the discovery.* *The ESMP presents the Cultural and Heritage Management Plan including a Chance Find Procedure, which has considered the provisions of this Act.*
Roads and Land Use Planning		
Roads	• *Roads and Road Traffic Act (Cap 464)*	*Part III and IV of this Act include provisions for the registration and licensing of motor vehicles and trailers. Such provisions include ownership details, vehicle/trailer specifications, etc. Moreover, Part V includes the requirements for the licensing of drivers of motor vehicles and Part VII includes the provisions for third part insurance.* *The Act stipulates that no person shall drive a motor vehicle on a road unless he is the holder of a valid licence issued to him in respect of motor vehicles of the class concerned. The Act provides the minimum age limits associated with driving of vehicles on roads. Part VI includes the provisions for motor vehicle insurance against third party. Part XI includes the provisions for road safety and*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
		driving offences (speed limits, reckless driving, driving under the influence, driving behaviors, vehicle emissions, littering etc.). *The ESIA and ESMP presents Road Safety Management and Traffic and Transport Management measures. The provisions of this Act have been included in these measures.*
Land use planning issues	• *Town and Country Planning Act, Cap 283, 1962, as amended.*	*Provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land.*
	• *Lands Conversion of Titles Act*	*Provides for alienation, transfer, disposition and charge of land.*
	• *Lands and Deeds Registry Act, Cap 174*	*An Act to provide for the registration of documents; to provide for the issue of Provisional Certificates of Title and Certificates of Title; to provide for the transfer and transmission of registered land; and to provide for matters incidental to or connected with the foregoing.*
	• *Lands Act, Cap 173, 1995*	*The Act guarantees peoples' right to land while enhancing development. The Act recognizes the holding of land under customary tenure and the Chief's role has been legally recognised, such that land cannot be converted or alienated without approval of the chief.*
	• *Land Acquisition Act No. 2 of 1970*	*The Act sets out regulations for compulsory acquisition of land and property and compensation for such acquisition.*
	• *Agricultural Lands Act No. 57 of 1960*	*Provides for the establishment of the Agricultural Lands Board and provides for tenant farming schemes.*
	• *The Local Government Act, No 13 of 2010*	*Provides for the establishment of Councils or Districts, the functions of local authorities and the local government system. Some of these functions relate to pollution control and the protection of the environment in general.*
Mining Regulations		
Quarries and Borrow Pits	• *Mines and Minerals Development Act, 2008*	*Regulates the law relating to mines and minerals. The Act provides for the granting of or, renewal and termination of mining rights. It also provides for the control of mining activities with regard to environmental protection.*
Investments, Energy Regulation, and Development		
Tourism	• *Tourism and Hospitality Act, No 23 of 2007*	*Provides for the promotion of tourism activities both locally and internationally.*
Investment and Taxes	• *Public – Private Partnership Act, No 14 of 2009*	*Provides for the encouragement of private sectors partnering with the government in the development and execution of certain nationally important projects*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
	• *Zambia Development Agency Act No 11 of 2006*	*An Act to foster economic growth and development by promoting trade and investment in Zambia through an efficient, effective and coordinated private sector led economic development Strategy.*
	• *The Zambia Revenue Authority Act (No. 28 of 1993 and all amendments);*	*The Acts provides for the taxation system in Zambia for various goods and services.*
	• *Investment Act of 1998*	*Provides a legal framework for investment in Zambia. The Act relates to the environment by encouraging investment that is not detriment to the environment.*
	• *Standards Act, Cap 416*	*Provides for the adherence to prescribed standards in all works.*
Employment and Compensation	• *Citizens Economic Empowerment Act No 9 of 2006*	*Provides for the encouragement and support of citizens of Zambia to get involved in business activities for wealth creation and support of livelihoods.* *More specifically, Part II of the Act provides measures for economic empowerment including (amongst others) the prohibition of discrimination, skills development, education and training, preferential procurement, regional development, codes of good practice and mechanisms for measuring progress.* *The ESIA and ESMP provide measures to ensure that the Kariba Dam Rehabilitation Project provides opportunities to Zambian citizens.*
	• *The Employment Act Cap 268*	*Provide for the employment of persons on contracts of service and for the form of and enforcement of contracts of service, appointment of officers of the Labour Department and for the conferring of powers on such officers and upon medical officers and protection of wages of employees as well as control of employment agencies.*
	• *Compensation Act (No 10 of 1999)*	*Provides for the 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.*

4.1.3 *Zambian Development Policies*

The national development policies for Zambia that are of applicability to this Project are briefly outlined below.

Zambia Vision 2030

Vision 2030 expresses Zambia's aspirations in respect of economic growth, good governance and developing its people. One key basic principle of Vision 2030 is sustainable development. The vision is supported by key goals to ensure that by the year 2030:

- Zambia's rural and urban population has universal access to clean, reliable and affordable energy by the use of alternative, renewable energy sources such as hydropower.

- There is an upgrade of existing and construction of new infrastructure by developing and implementing private- public partnerships with both local and international industries.

- Zambia's biodiversity is protected in numerous national parks and local forest reserves. There is maintenance of a productive environment and well conserved natural resources to facilitate sustainable socio-economic development.

- There is effective utilisation of fresh water resources for a variety of purposes whilst maintaining the quality of the source.

Sixth National Development Plan: 2011 – 2015

The Sixth National Development Plan (SNDP) aims to materialise the aspirations of the Vision 2030. The objectives of the SNDP are:

- Infrastructure development;
- Economic growth and diversification;
- Rural investment; and
- Poverty reduction and the enhancement of human development.

The SNDP contains sector plans that aim to assist in achieving these objectives. The sector plans most relevant to the Project and their objectives are summarised below.

Energy Sector Plan

- To increase electricity generation capacity by at least 1,000MW and build appropriate transmission lines.

- To increase electrification levels in rural areas of Zambia to 15 %, particularly in the Central Province.

- To expand the use of renewable and alternative energy in the country's energy mix.

- To reduce greenhouse gas emissions from the energy sector and strengthen adaptation and resilience to climate change related stresses.

Water Sector Plan

- To achieve sustainable water resource development for social and economic development.

- To develop innovative approaches and appropriate technologies for the effective management of the nation's water resources.

Southern Province Regional Development Plan: 2011 - 2015

The Southern Province Regional Development Plan (as set out within the SNDP) provides for a variety of sector specific strategies and programmes to be achieved in the SNDP period. The objectives of some of these strategies and programmes applicable to the Project include:

- Infrastructure development for the movement of goods and services;
- Connecting rural areas to electricity power supply; and
- Expanding and improving infrastructure for electricity generation, transmission and distribution.

Energy White Paper (February 2010)

A national energy study was implemented by Chubu Electric Power Co., Inc. from November 2008 to February 2010, in order to formulate a countrywide power system development master plan. The study was undertaken cooperatively with the Zambian Ministry of Energy and Water Development.

The objectives of the study were to inform the Power System Development Master Plan until 2030, coordinating generation, transmission, and an interconnection plan for the stabilization of the power supply for Zambia and the southern African community. In addition to this, the study was intended to transfer technical skills.

Applicability to Project

These policies have been taken into account during the development of the ESIA and ESMP for the proposed Kariba Dam Rehabilitation Project and the development of social and environmental mitigation/management commitments. More specifically, the principal of sustainable development (highlighted in the Zambian Vision 2030) was the underlying theme for the development of mitigation/management measures, particularly for the safe guard of fresh water resources.

The Sixth National Development Plan: 2011 – 2015 and Southern Province Regional Development Plan were considered as part of the development of social commitments. The theme of the SNDP is "*sustained economic growth and poverty reduction*". Furthermore, key objective of the SNDP relevant to the proposed Project include rural investment and poverty reduction and enhanced human development. The proposed Project will aim towards the creation of employment opportunities and skills development in the local areas and (where possible) the support of local businesses. Any form of Corporate Social Investments would need to align these investments with that of the Southern Province Regional Development Plan: 2011 - 2015.

4.2 *ZIMBABWE*

4.2.1 *Zimbabwean Institutional and Organisational Framework*

Ministry of Environment, Water and Climate

The ministry with overall responsibility for environmental management in Zimbabwe is the Ministry of Environment, Water and Climate, formerly known as the Ministry of Environment and Natural Resource Management, and the Ministry of Mines, Environment and Tourism. As per the Zimbabwean Environmental Management Act (Chapter 20:27) the general functions of the Minister of Environment, Water and Climate are to:

- Regulate the management of the environment and promote, coordinate and monitor the protection of the environment and the control of pollution.
- Regulate the activities of all government agencies and other agencies in terms of their impact on the environment.
- Present to Parliament a report on the state of the environment every five years.
- Monitor the environment, trends in the utilisation of natural resources, and the impact of such utilisation on the environment.
- Coordinate the promotion of public awareness and education on environmental management.
- Ensure that persons and institutions responsible for causing environmental harm meet the cost of remedying that harm.

- Formulate policies for environmental management and facilitate their implementation.

- Recommend to the government which international and regional conventions and treaties on the environment Zimbabwe should become a party to, and secure their incorporation into domestic law.

Environmental management is regulated by three related agencies in the Ministry of Environment, Water and Climate; namely the National Environmental Council (NEC), the Environmental Management Agency (EMA) and the Environmental Management Board (EMB).

National Environmental Council (NEC)

The functions of the NEC are as follows:

- Give advice on policy formulation and provide directions on the implementation of the Zimbabwean EMA.

- Give advice on national goals and objectives for the protection of the environment.

- Promote cooperation among public departments, local authorities, the private sector, non-governmental organisations and other organisations that deal with environmental issues.

- Review and recommend to the Minister guidelines for environmental management plans and environmental action plans.

- Review national environmental policies, plans and strategies.

Environmental Management Agency

The Environmental Management Act of 2002 (Chapter 20:27) provides for the establishment of the Zimbabwean Environmental Management Agency (EMA), formerly known as the Department for Natural Resources. The Agency is responsible for:

- Formulating quality standards on air, water, soil, noise, vibration, radiation and waste management.

- Assisting and participating in any matters pertaining to the management of the environment, such as:

    - Developing guidelines for National Plans, environmental management plans and local environmental action plans;

    - Regulating and monitoring the collection, disposal, treatment and recycling of waste;

- Monitoring and regulating the discharge or emission of pollutants or hazardous substances into the environment;

- Keeping records in the form of registers of all licences and permits issued under the law;

- Monitoring and regulating the control of invasive alien species;

- Regulating, monitoring, reviewing and approving EIAs;

- Regulating and monitoring the management and utilisation of ecologically fragile ecosystems;

- Making bylaws within the jurisdiction of local authorities;

- Advising government on conventions and treaties that should be incorporated into national law;

- Coordinating the production of a five-year environmental report;

- Developing and implementing incentives for the protection of the environment;

- Carrying out periodic environmental audits of any projects, including projects whose implementation started before a fixed date, to ensure that their implementation complies with the requirements of the Act;

- Regulating and monitoring access by any person to biological and genetic resources; and

- Making recommendations to the Minister on the formulation of any regulations.

Environment Management Board

The Zimbabwean EMA is controlled and managed by the Environment Management Board (EMB), which is composed of experts from the areas of environmental planning and management, environmental economics, ecology, pollution, waste management, soil science, hazardous substances, water and sanitation. In addition, there is a legal representative and a secretary to the Ministry responsible for the environment.

Applicability to the Project

The Zimbabwean Environmental Management Agency (EMA) falls under the Ministry of Environment, Water and Climate. The Ministry of Environment, Water and Climate regulates the activities of the EMA and regulates management and protection of the environment and control of pollution. Accordingly, the Ministry of Environment, Water and Climate and the EMA are mandated to ensure that the proposed Project is undertaken in a way that complements Chapter 20:27 of the Zimbabwean Environmental Management Act.

Department of Water

The Department of Water within the Ministry is responsible for the oversight of the water sector. The functions of the Ministry include:

- Formulate and implement sustainable policies on the development, utilization and management of water resources in cooperation with user communities and institutions.
- Design, construct and maintain medium to large size dams and water supplies to satisfy present and future domestic, industrial and mining water requirements.
- Provide clear/treated water for urban areas in consultation with the Ministry of Local Government, Public Works and Urban Development.
- Design, construct and maintain dams, weirs and boreholes to meet present and future irrigation requirements.
- Take responsibility for the overall/national planning, management, regulation and standardisation of irrigation development and adoption of appropriate technology.
- Design, construct, maintain and manage irrigation schemes and projects.
- Develop sustainable underground water resources in consultation with the Ministry of Rural Housing and Social Amenities.
- Manage the water resources of the country (water in rivers, dams and ground water).
- Set tariffs for raw water, treated water and irrigation water in consultation with other line ministries, consumers and stakeholders.
- Manage and administer the Water Fund through the Zimbabwe National Water Authority.
- Administer the District Development Fund.
- Administer the Rural Capital Development Fund.

* Participate in the development and implementation of SADC and other regional and international organisations' water resources management frameworks.

The Zimbabwe National Water Authority (ZINWA)

ZINWA is a parastatal, which acts as an operator and a regulator. ZINWA is responsible for the following functions at the national level:

* Water planning and implementation;
* Management of public dams;
* Supply of bulk water to the agriculture, industrial and mining sectors;
* Supply of bulk water to urban centres; and
* Coordination and supervision of the seven catchment councils.

ZINWA is responsible for water supply to urban centres, while the municipalities supply water to smaller urban settlements. Rural water supply and sanitation is coordinated by the National Action Committee for Water and Sanitation, which is an inter-ministerial committee chaired by the Minister of Local Government. Separating rural and urban domestic water supply into different ministries was identified by SADC (2003a) as leading to the rural water supply perspectives being isolated from the national water program.

The seven Catchment Councils (Gwayi, Manyame, Save, Runde, Mazowe, Sanyati and Mzingwane) established under the Zimbabwe National Water Authority Act are responsible for all aspects of water management within their responsive catchment areas. The Catchment Managers are employees of ZINWA, and not employed by the Catchment Council, which hinders the devolution of authority. Sub-Catchment Councils are under Catchment Councils and Water User Boards are the lowest tier.

Applicability to the Project

The proposed Project has the potential to impact on the hydrology and water quality of the Zambezi River downstream of the excavation works associated with rehabilitation of the plunge pool. Accordingly, the Zimbabwean Department of Water and the Zimbabwean National Water Authority (ZINWA) are considered as Key Stakeholders in the ESIA process.

Ministry of Energy and Power Development

The Ministry is the administering authority in regards to energy and power development in Zimbabwe. The Ministry comprises the following departments:

* Petroleum;
* Power Development;
* Policy And Planning;
* Energy Conservation and Renewable Energy;

- Finance Human Resources and Administration;
- Legal Services; and
- Internal Audit.

The Power Development Department

The Power Development Department is one of the technical departments of the Ministry. Its main role is to facilitate the improvement of availability of electricity to the populace, as well as the attainment of self-sufficiency in electricity generation. The achievement of the strategic goals is centred on the effective administration of the utilities under the Department's purview namely ZESA Holdings (Pvt) Ltd and its subsidiaries: Zimbabwe Power Company (ZPC), Zimbabwe Electricity Transmission and Distribution Company (ZETDC), ZESA Enterprises (ZENT); the Rural Electrification Agency (REA); Zimbabwe Electricity Regulatory Commission (ZERC) and Zambezi River Authority (ZRA) which is a bilateral body owned by Zimbabwe and Zambia.

The Zimbabwe Energy Regulatory Authority (ZERA)

ZERA was created in September 2011 following the promulgation of the Energy Regulatory Act (Chapter 13:23). Its primary mandate is to regulate the Energy Sector in Zimbabwe. The functions of ZERA include:

- Regulatory and Licensing:

    - To regulate the procurement, production, transportation, transmission, distribution, importation and exportation of energy derived from any energy source.

    - To exercise licensing and regulatory functions in respect of the energy industry.

    - To ensure that prices charged by licensees are fair to consumers in the light of the need for prices to be sufficient to allow licensees to finance their activities and obtain reasonable earnings for their efficient operation.

    - To establish or approve operating codes for safety, security, reliability, quality standards and any other sector related codes and standards for the energy industry or any sector thereof.

    - To maintain and promote effective competition within the energy industry.

- Research and development:

    - To promote and encourage the expansion of the energy industry and the advancement of technology relating thereto.

- To promote, identify and encourage the employment and development of sources of renewable energy.

- To undertake such other thing which it considers is necessary or convenient for the better carrying out of or giving effect to the functions of the Authority.

- To increase access and security of supply:

    - To promote the procurement, production, transportation, transmission and distribution of energy in accordance with public demand and recognised international standards.

    - To ensure the maximisation of access to energy by all consumers that is affordable and environmentally sustainable.

    - To create, promote and preserve an efficient energy industry market for the provision of sufficient energy for domestic and industrial use.

    - To promote coordination and integration in the importation, exportation and pooling of energy from any energy source in the SADC and COMESA region.

- Energy efficiency and environmental protection:

    - To advise and educate consumers and licensees regarding the efficient use of energy.

    - To assess, promote studies of and advise the Minister and licensees on the environmental impact of energy projects before licensing.

- Key stakeholder advisory role:

    - To advise the Minister on all matters relating to the energy industry.

    - To establish appropriate consumer rights and obligations regarding the provision of energy services.

    - To arbitrate and mediate disputes among and between licensees and consumers.

    - To represent Zimbabwe internationally in matters relating to the energy industry.

Applicability to the Project

The Kariba contains two separate hydropower plants: one on the Zambian side and one on the Zimbabwean side of the Zambezi River. As the proposed Project (and in particular the excavation works in the plunge pool) has the potential to impact on the two hydropower plants, the Ministry of Energy and Power Development and associated Power Development Department and Zimbabwe Energy Regulatory Authority are considered as Key Stakeholders in the ESIA process.

National Museums and Monuments of Zimbabwe (NMMZ)

NMMZ is Zimbabwe's premier heritage organization established under the National Museums and Monuments of Rhodesia Act, 1972 which is now called the National Museums and Monuments Act (Chapter 25:11). NMMZ is a Parastatal, funded through grant by Central Government and falling under the Ministry of Home Affairs. The Act established a Board of Trustees to provide for the establishment and administration of museums' and to provide for the preservation of ancient, historical and natural monuments, relics and other objects of historical or scientific value or interest.

Applicability to the Project

Although it is not anticipated that there are any cultural heritage sites located in the Project Area, there may be sub-surface archaeological resources that could fall within the footprints of proposed ground disturbing activities. Accordingly, the National Museum and Monuments of Zimbabwe (NMMZ) is considered a Key Stakeholder in the ESIA process.

Other Line Ministries:

Due to the cross-sector impacts of the Project other Ministries and Agencies are also of relevance, such as:

- Ministry of Lands and Rural Resettlement
- Ministry of Industry and Commerce;
- Ministry of Health and Child Care;
- Ministry of Local Government, Public Works and National Housing;
- Ministry of Lands and Rural Settlement;
- Ministry of Agriculture, Mechanisation & Irrigation Development; and
- Ministry of Public Service, Labour and Social Welfare.

Applicability to the Project

The proposed Project has the potential to impact on the receiving socio-economic environment. Accordingly, these other line Ministries are considered as Key Stakeholders in the ESIA process.

4.2.2 *Zimbabwean Environmental and Social Laws and Regulations*

Constitution of Zimbabwe Amendment Act (No. 20 of 2013), Section 73 (Environmental Rights)

According to Section 73 of the Constitution of Zimbabwe, every person has a right to an environment that is not harmful to their health or well-being and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures. To this end, the State must take reasonable legislative and other measures, within the limits of the resources available to it, to achieve the progressive realisation of the rights set out in this section.

1. Every person has the right –

a. To an environment that is not harmful to their health or well-being; and
b. To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that –

i. Prevent pollution and ecological degradation;
ii. Promote conservation; and
iii. Secure ecologically sustainable development and use of natural resources while promoting economic and social development.

2. The State must take reasonable legislative and other measures, within the limits of the resources available to it, to achieve the progressive realisation of the rights set out in this section.

Applicability to the Project

Other than Section 73, the current Constitution has no specific clause that provides for the protection of the environment.

The objective of this ESIA and ESMP is to ensure for the protection of the environment and associated key natural socio-environmental resources.

The Environmental Management Act (the Act) (Chapter 20:27), No. 13 of 2002

The Zimbabwean Environmental Management Act (the Act) (Chapter 20:27), No. 13 of 2002, was enacted in 2002 and amended on 17 May 2011, under the General Laws Amendment Act, 2011 (No 5 of 2011) Government Gazette number Vol LXXXIX, No 23. It aims to 'provide for the sustainable management of natural resources and protection of the environment; [and] the prevention of pollution and environmental degradation'.

The Act also provides for the establishment of EMA and an Environmental Fund. The Act repeals the following former Acts:

- Natural Resources Act (Chapter 20:13);
- Atmospheric Pollution Prevention Act (Chapter 20:03);

- Hazardous Substances and Articles Act (Chapter 15:05); and
- Noxious Weeds Act (Chapter 19:07).

The Act is a general legislative framework and does not cover every environmental aspect. It is a framework law which will be complemented by other laws and policies that are not in conflict with it. However, where there are conflicts, this Act will take precedence. The law will be supported by the setting up of the proposed institutions and the promulgation of Regulations by the Minister. Nevertheless, the Act provides the general environmental principles that should be followed in environmental management.

The provisions of the Zimbabwean EMA that relate to EIAs in particular are set out in Section 97 of the Act and summarised below:

- A person who proposes to embark on any of the projects listed in the First Schedule is expected to submit an EIA report to the Director-General.

- The developer can only embark on the project if s/he has obtained a certificate from the Director-General.

- The developer is expected to submit a prospectus to the Director-General with information on the assessment and the project.

- It is an offence for any person to knowingly implement a project without a certificate showing that an EIA has been carried out and approved.

Some of the sectors in which EIAs should be carried out include:

- Dams and man-made lakes;
- Drainage and irrigation;
- Housing developments;
- Industry;
- Mining and quarrying;
- Petroleum production, storage and distribution;
- Power generation and transmission;
- Tourist resorts and recreational developments;
- Waste treatment and disposal;
- Water supply;
- Conversion of forest land into other use; and
- Conversion of natural woodland to other use within the catchment area of reservoirs used for water supply, irrigation or hydropower generation or in areas adjacent to parks and wildlife estates.

Applicability to the Project

General Management Requirements

This Act aims to provide for the sustainable management of natural resources and protection of the environment; [and] the prevention of pollution and environmental degradation. Section 4 the Act affords all citizens of Zimbabwe the right to live in a clean environment that is not harmful to their health; access to environmental information; the right to protect the environment for the benefit of present and future generations; and the right to participate in the implementation of legislation and policies that prevent pollution and environmental degradation and promote the sustainable management and use of natural resources, as well as justifiable economic and social development.

The Act also includes provisions for aspects including (amongst others) water, air, waste, hazardous wastes, noise, toxic substances, wetlands and control of invasive plant species. These provisions will be discussed in the relevant sections below.

Provisions for Water

Section 57 of the Act mentions that any person, who discharges or applies any poison or toxic, noxious or obstructing matter, radioactive waste or other pollutants or permits any person to dump or discharge such matter into the aquatic environment in contravention of water pollution control standards shall be guilty of an offence.

Provisions for Terrestrial Ecology

Part XIII of the Act includes provisions for the control of alien plant species. Essentially, every person has the responsibility to clear or cause to be cleared any invasive alien species growing or occurring on the land in respect of which he is responsible.

Provisions for Air Quality

Section 63 of the Act mentions that ambient air quality standards need to be established.

Provisions for Noise

Sections 79 to 81 (in Part IX of the Act) provide requirements around noise management. More specifically, the Act mentions the need for standards to be established for the emissions of noise and vibration pollution. Section 80 mentions that any person who emits noise in excess of the noise emission standards prescribed in terms of section seventy-nine shall be guilty of an offence.

No reference to noise standards could be sourced and it appears as if these do not yet exist.

Provisions for Waste

Section 69 of Part IX of the Act mentions that no person shall discharge or dispose of any wastes, whether generated within or outside Zimbabwe, in such a manner as to cause pollution to the environment or ill health to any person. Moreover, Section 69 includes provisions for the transport and disposal of waste.

Section 73 of the Act prohibits the discharge of hazardous substances, chemicals and materials or oil into the environment.

All these provisions have been considered in the Kariba Dam Rehabilitation ESIA and associated ESMP.

Environmental Management (Environmental Impact Assessments and Ecosystems Protection) Regulations, SI No. 7 of 2007

The Environmental Management (Environmental Impact Assessments and Ecosystems Protection) Regulations (EIA Regulations) deal with the regulation of the EIA process and the protection of ecosystems. Part 11 of the Act stipulates that no industrial project shall be implemented without an EIA having been done. These Regulations provide the methodology for undertaking the EIA. The developer has to submit a prospectus to the EMA (see section 16.4.1), which will issue a licence if satisfied by the contents of the prospectus. The prospectus has to contain details of the environmental impacts of the project and the measures to be taken to contain or mitigate such impacts. In preparing an EIA, a developer is obliged to consult widely with all stakeholders. The EMA will not issue a licence if it is not satisfied that the developer consulted with all stakeholders in the preparation of the prospectus. It should also be noted that projects that began before the Act was promulgated are subject to periodic environmental audits by the EMA.

Section 10 (4 to 7) of the EIA Regulations state the following:

- Before any EIA report is furnished to the Director-General, the developer shall carry out wide consultations with stakeholders.

- During review of the prospectus and EIA report, the Director-General shall verify whether full stakeholder participation was undertaken when the EIA report was prepared. [(1)]

- Expenses associated with the stakeholder consultation process should be borne by the developer.

- The Director-General may advertise in the print and electronic media when a prospectus or EIA report is being reviewed.

Regrettably, the Regulations neither provide specifically for the manner in which the consultation of stakeholders should be carried out nor do they stipulate the stakeholders. There is also no measure to ensure that the concerns of the stakeholders are incorporated in the prospectus.

Applicability to Project
The ZRA have contracted ERM to undertake an independent Environmental and Social Impact Assessment (ESIA) Process. The ESIA process compliments and fulfils the requirements of Zimbabwean EIA regulations.

(1) Note: Proof of stakeholder consultation must be included in the EIA report (these include letters confirming public consultation from relevant Government Agencies). Obtaining proof of consultation from the relevant Government Agencies can be time consuming (and in some cases these Agencies request payment).

Environmental Impact Assessment Guidelines (1997)

In 1997, the then Ministry of Mines, Environment and Tourism published the Environmental Impact Assessment Policy. The goal of the policy is to encourage environmentally responsible investment and development in Zimbabwe. The policy views the EIA process as key to achieving this goal.

To support the 1997 Environmental Impact Assessment Policy, the Ministry of published EIA Guidelines to facilitate the implementation of the EIA process. These guidelines are presented as 10 Volumes.

Volume 1 provides guidance on the EIA Policy and General Guidelines under the following topics:

- Administering the EIA Policy;
- Preparing Terms of Reference (ToR's);
- Preparing EIA Reports;
- Consulting the Public [1];
- Environmental Management; and
- Evaluating the adequacy of EIA Reports.

In terms of consulting the public, Section 5 provides guidelines for the stakeholder consultation programme.

Volumes 2 to 10 provide guidance on sector-specific EIAs and cover the following sectors:

- Mining and quarrying
- Forestry
- Agriculture
- Transport
- Energy
- Water
- Urban infrastructure
- Tourism.

For each of these sectors, the guidelines provide examples of major activities that are likely to be undertaken for projects in that sector, the type of environmental impacts, possible measures for managing such impacts, sample Terms of Reference, and sources of information for use in an EIA study.

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(1) According to the Environmental Impact Assessment Policy, public consultation is an integral component of the EIA Policy, and includes three principal elements:

- Proponents are required to conduct public participation during the preparation of EIA reports;
- During the review of draft EIA reports, the Natural Resources Board may conduct public meetings on an activity where warranted; and
- EIA documents will be available for public review and comment.

In addition, the guidelines are supported by various appendices which provide guidance on preparing ToR's, EIA methods, sources of information, etc.

The guidelines are used by Government authorities, developers and EIA practitioners as they provide valuable assistance with carrying out EIAs, guidance on the review of EIAs and the implementation of the EIA recommendations. In addition, the guidelines contribute to improving the quality of sector-specific EIAs.

Applicability to Project

The ZRA have contracted ERM to undertake an independent Environmental and Social Impact Assessment (ESIA) Process. The ESIA process compliments and fulfils the requirements of Zimbabwean EIA guidelines.

Other Relevant Environmental and Social Legislation in Zimbabwe

Environmental issues cut across a wide variety of sectors, and as such there are numerous pieces of legislation in Zimbabwe which have a bearing on the environment and should be considered in ESIA decision-making.

Table 2.2 presents a summary Zimbabwean national legislation.

PLEASE NOTE:

Table 4.2 does not provide a detailed description for the all legislative instruments; rather, the legislative instruments deemed applicable for the proposed Kariba Dam Rehabilitation Project and the associated Environmental and Social Management thereof have been elaborated on in terms of their applicability to the proposed Project.

Table 4.2 Summary of Relevant Zimbabwean Environmental and Social Legislation

Component	Applicable Legislative Instrument	Description of Legislative Instrument
		Environmental
Water Resources	• *Water Act, 2003 (Chapter 20:24)*	*Section 67 of the Act states that water resource management needs to be consistent with environmental approaches and due consideration should be given to the protection, conservation and sustenance of the environment; and the right of access by members of the public to places of leisure or natural beauty related to water or water bodies.* *According to Section 69, a person who intends to discharge or dispose into a water course shall apply for a permit and pay such charges, for the use of the water, as may be prescribed. It is the understanding of this process that a water permit will not be necessary for this Project.* *Part IX includes provisions on the safety of dams. Namely Section 109 and 110 include requirements around procedures for emergency for any sudden or unprecedented flood or alarming or unusual circumstance or occurrence, whether anticipated or existing, which may adversely affect the dam.* *Such management measures have been considered in ESIA and associated ESMP, particularly for surface water quality management and dam safety management.*
	• *Zimbabwe National Water Authority Act, 1998 (Chapter 20:25)*	*Establishes the Zimbabwe National Water Authority and to provide for its functions. Provides for the appointment and functions of a board of the Authority and for the raising of charges for the provision of water and other services by the Authority. In addition, the Act provides for the funds of the Authority and the imposition and collection of a water levy. The Act also repealed the Regional Water Authority Act.*
Wildlife and Natural Resources	• *Forest Act, 1948 (Chapter 19:05)*	*Provides for demarcating and conserving forests and nature reserves.* *More specifically, Part VI (conservation of timber resources) governs the removal of indigenous trees. Prior to the removal of indigenous trees, notice of intention must be provided to the appropriate Commission.* *Management/mitigation commitments for the protection of terrestrial flora are included in this ESIA and associated ESMP.*
	• *Parks and Wildlife Conservation Act, 1975 (Chapter 20:14)*	*Provides for the conservation and control of wildlife, fish and plants; and designates specially protected animals and indigenous plants.* *More specifically, Part IX (specially protected animals) (Section 45) and Part XII includes provisions around the hunting, removal of animals and animal products.* *Part X and Part XI of the Act include provisions for protected plants specified in the Seventh Schedule*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
		(insertion by Act 19 of 2001 with effect from the 1st June, 2002) and provisions for the control of picking of indigenous plants. *The management of terrestrial ecology and revegetation and rehabilitation for the Kariba Dam Rehabilitation Project has considered the provisions of this Act.*
	• *SI 61 of 2009 Environmental Management (Access to Genetic Resources and Indigenous Genetic Resource Best Knowledge)*	*The SI requires stakeholders (including communities) to be consulted where access to genetic resources is given to external parties, promoting community participation in the management of genetic resources. Consultation, which is a key aspect of good governance of natural resources, is strengthened by the requirement of Prior Informed Consent.*
	• *GN 380 of 2013 (Protection of Wetlands) per Section 113 of the Environmental Management Act*	*This Section of the Act includes provisions for the protection of wetlands in Zimbabwe. Such controls include the preservation of beds, banks; controlling stormwater; restrictions of removing clays and deposits from wetlands; reducing pollution of any kind to wetlands and restoration of wetlands.* *The management of surface water quality, aquatic environments (including aquatic vegetation) and terrestrial ecology (including fauna utilising wetland habits) is considered in the ESIA and associated ESMP.*
	• *Communal Land and Forest Produce Act, 1988 (Chapter 19:04)*	*Controls the use of wood resources within communal lands. Such resources are only for the domestic use of the residents.*
Air	• *Air Pollution Control Regulations SI 72, 2009.*	*Provides for prevention, control and abatement of air pollution to ensure clean and healthy ambient air.* *The provisions of these regulations have been considered in the Air Quality and Dust Management Plan (refer to ESMP in Part III).*
	• *Draft Air Quality and Emission Standards (draft number EN 005 - D977/2)*	*These have not been enacted; however, Section 4 of these draft standards provides ambient air quality in Zimbabwe. Moreover, Section 7 provides limit values for vehicle emissions.*
Waste	• *Effluent and Solid Waste Disposal Regulations SI 6, 2007.*	*This regulation concerns the disposal of effluent and solid wastes. Persons are prohibited from disposing waste into public water courses without initially acquiring permission. Moreover, a generator of waste (other than domestic households) is now required to produce a Waste Management Plan. The plan should deal with sound environment management of wastes.* *Although waste related impacts have not been included in the ESIA, the ESMP presents a Waste Management Plan. Moreover, the ESMP presents a Rehabilitation and Revegetation Plan. These plans have considered the provisions of these Regulations.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
	• *Hazardous Waste Management Regulations SI 10, 2007*	*Provides for the licensing for generation, storage, use, recycling, treatment, transportation or disposal of hazardous waste. Generators of hazardous waste are also required to prepare waste management plans and targets. Regulates waste collection and management by local authorities. In addition, regulates the importation and exportation of hazardous waste and waste oils.* *According to this regulation, generators of hazardous waste are required to prepare waste management plans.* *The ESMP includes a Waste Management Plan, which includes commitments around the management of hazardous waste.*
	• *Environmental Management (Plastic Packaging and Plastic Bottles) SI 98 of 2010*	*The Plastic Bottles and Plastic Packaging Regulations encourage a reduction in the use of certain types of plastics. According to Article 3(1), it is prohibited to produce, import or distribute plastic packaging with a thickness of less than 30 microns.* *The Waste Management Plan (refer to ESMP in Part III) encourages minimization of waste generation and maximization of reuse and recycling of waste products.*
Explosives	• *Explosives Act (Chapter 10:08)*	*Part IV of this Act includes provisions for the storage of explosives. No person shall keep explosives in or on any premises unless the premises are licensed. Moreover, Part V of the Act governs the use of explosives. Part VI provides restrictions and provisions for the transport of explosives.* *The ESMP includes provisions for blasting management. The development of these provisions has taken this Act into consideration. Moreover, detailed design around blasting management for the Kariba Dam Rehabilitation Project has and will take these requirements into consideration.*
	Energy	
Energy	• *Electricity Act (Ch 13:19)*	*Provides for the establishment of the Zimbabwe Electricity Regulatory Commission and provides for its functions and management. Also provides for the licensing and regulation of the generation, transmission, distribution and supply of electricity.*
	• *Energy Regulatory Act (Chapter 13:23)*	*Provides for the creation of the Zimbabwe Energy Regulatory Authority (ZERA) and regulates the energy sector and other sections not provided for by the energy laws, the Electricity Act (13:19) and Petroleum Act (13:22). The Energy Regulatory Act repealed some sections especially those related to the formation of the regulatory institutions in the Electricity Act (Chapter 13:19) and Petroleum Act (Chapter 13:22). The mandate of ZERA is to regulate the Energy Sector in Zimbabwe.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
Socioeconomic, Archeology and Cultural Heritage		
Health	• *Public Health Act (Ch 15:09)*	*Provides for the establishment of the Zimbabwean public health system.*
	• *Regulation 12 of 2007 Environmental Management Act (Hazardous Substances, Pesticides and other Toxic Substances)*	*The Regulations prescribe conditions that employers have to observe in the handling of hazardous substances at the workplace, conditions for transporting hazardous substances, and procedures to be followed when there is an accidental spillage of hazardous substances.* *The Agency is empowered to issue spot fines to any person who violates the law. In addition, any person whose substances affect the environment is liable to pay for the cost of restoring the environment (i.e. the polluter pays principle). The offender is also liable to pay compensation for any damage that the offence caused to any person.*
	• *Environmental Management (Hazardous Waste Management) Regulation 10 of 2007*	*The Environmental Management Act (Chapter 20:27) Section 140 read with Statutory Instrument 10 of 2007 (see above), regulates the handling of hazardous waste. Under the regulations, the collection, storage, treatment and transportation is strictly prohibited unless under a license issued by the Environmental Management Agency. The regulations also stipulate that no person shall generate, store, sell, transport, use, recycle, treat, discharge or dispose of hazardous waste to the environment without seeking a permit or license from the Agency.*
Immigration	• *Immigration Act (Chapter 4:02)*	*Part III of this Act includes provisions for the entry of persons to Zimbabwe (viz. compliance with the directions of immigration officers, travel document requirements, entry refusals, etc.). Part V of the Act includes the provisions for departure of Zimbabwe.* *These provisions have been included in the Worker Health and Safety Plan included in the ESMP (refr to Part III of the ESIA).*
Protected Places and Areas	• *Protected Place and Areas (Chapter 11:12)*	*This Act includes the provisions for the control of entry of persons into certain places, for the protection of the premises. The control of access to work areas associated with the Kariba Dam Rehabilitation Project will be undertaken in accordance with the provisions/requirements in this Act.*
Archaeological, Historical and Cultural	• *National Museums and Monuments Act (Chapter 25:11)*	*Makes provision for the preservation of ancient, historical and natural monuments, relics and other objects of historical or scientific value or interest. Section 21 of the Act requires that the appropriate board be notified of any ancient monument or relic. Moreover, Section 24 states that no person may excavate and ancient monument or national monument without obtaining written permission by the appropriate Board.* *The Cultural and Heritage Management Plan (refer to the ESMP in Part III of this ESIA) includes a Chance Find Procedure, which has considered the provisions of this Act*
Land use planning issues	• *Communal Land Act (Chapter 20:04)*	*Provides for the classification of land in Zimbabwe as Communal Land and for the alteration of such classification; to alter and regulate the occupation and use of Communal Land; and to provide for matters incidental to or connected with the foregoing.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
	• *Rural District Councils Act, 1989 (Chapter 29:13)*	*Provides for the establishment of Rural District Councils responsible for initiating and regulating development in rural areas.*
	• *Regional Town and Country Planning Act [Chapter 29:12]*	*Regulates regional planning and provides for the functions of Regional Planning Councils. The Act confers the land-use planning function on urban local authorities and regulates the development of master and local plans; subdivisions, consolidation, acquisition and disposal of land.*
	• *Traditional Leaders Act (Chapter 29:17)*	*An Act to provide for the appointment of village heads, headmen and chiefs; to provide for the establishment of a Council of Chiefs and village, ward and provincial assemblies and to define their functions; to provide for the issue of village registration certificates and settlement permits. The Act also provides for the repeal of the Chiefs and Headmen Act (Chapter 29:01) and amends: the Criminal Procedure and Evidence Act (Chapter 9:07); the Communal Land Act (Chapter 20:04); and the Rural District Councils Act (Chapter 29:13).*
	• *Rural Land Act (Chapter 20:18)*	*An Act to provide for the acquisition of State land and the disposal of State land; to provide for the control of the subdivision and lease of land for farming or other purposes; to provide for limiting of the number of pieces of land that may be owned by any person and the sizes of such land, and for prohibiting or restricting the rights of non-residents to own, lease or occupy land in Zimbabwe, and to provide for other matters incidental to and connected with the foregoing.*
	• *Rural Land Occupiers (Chapter 20:26) (Protection from Eviction) Act 2002*	*Provides for the protection of certain occupiers of rural land from eviction, and regulates matters connected therewith or incidental thereto.*
Roads and traffic	• *Roads Act (Chapter 13:18)*	*Provides for the regulation of the standards applicable in the planning, design, construction, maintenance and rehabilitation of roads with due regard to safety and environmental considerations. Provides for road authorities and their functions and for the regulation of the erection of structures or the carrying out of works near certain roads, the entry upon roads from certain land and the acquisition of land and materials for road works.*
	• *Road Motor Transportation Act, 1997*	*The proposed Kariba Dam Rehabilitation Project will require the transport of materials and machinery into the Project Area. Part III (Section 7 to 16) of the Road Motor Transportation Act details the requirements for goods vehicles on all roads and that these vehicles/drivers need to hold an operator's license. The operator's license application needs to be assigned for a specific route. Part IV of the Act provides the requirements for the operation of foreign vehicles on Zimbabwean roads. Requirements include the provision of a foreign license. Part V includes the provisions for the inspection of vehicles and the issuance of a certificate of fitness for vehicles.* *The ESMP (refer to Part III of this ESIA) includes a Road Safety Management Plan and Traffic and Transport Management Plan. The provisions of this Act have been included in these.*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
	• *Road Traffic Act (Chapter 13:11)*	*Part II of this Act includes the provisions for the licensing of drivers of motor vehicles and the requirements for licenses (age limits, medical examinations, etc.). The Act stipulates that no person shall drive a motor vehicle on a road unless he is the holder of a valid licence issued to him in respect of motor vehicles of the class concerned, and complies with the conditions, if any, subject to which the licence was issued. Section 7 of the Act provides the minimum and maximum age limits associated with driving of vehicles on roads.* *Part III makes provision for the issuing of international driving permits. Section 17 states that any person who is an ordinarily resident in Zimbabwe; and the holder of a driver's licence or foreign drivers licence and who wish to drive a motor vehicle outside Zimbabwe, he must apply for an international driving permit.* *Part IV through to V (and VA) includes the provisions for motor vehicle insurance against third party. Part VI includes the provisions of traffic signs and police directions and the requirements around conformance.* *The ESMP (refer to Part III of this ESIA) includes Road Safety Management Plan and Traffic and Transport Management Plan. The provisions of this Act have been included in these.*
Mining Regulations		
Quarries and Borrow Pits	• *Environmental Management Act 2011(Section 23)*	*Quarries and borrow pits are regulated in terms of the first schedule of the Environmental Management Act. The Project will ensure that materials are sourced from licensed sites.*
	• *Statutory Instrument 3 of 2011*	*Regulates borrow pits and sites used for the extraction of sand and rock and associated transportation.*
Investments, Energy Regulation, and Development		
Tourism	• *Tourism Act (Chapter 14:20)*	*An Act to establish a Zimbabwe Tourism Authority and to provide for its functions; the appointment and functions of a board of the Authority; to establish a Zimbabwe Tourism Fund; the appointment of a Chief Executive of the Authority, licensing officers and other officers; the designation, registration and grading of tourist facilities and for the licensing of persons who provide services connected with tourism; the imposition and collection of levies in respect of designated tourist facilities; and matters connected with or incidental to the foregoing.*
Employment and Compensation	• *Labour Act (Chapter 28:01) as amended by Labour Act [Chapter 28:01] amended 2006 and the Labour Amendment Act, 2005 (Act 7/2005)*	*An Act to declare and define the fundamental rights of employees. Part II (Sections 4 to 7) provides the fundamental rights of employees, including entitlement to be a member of a trade union, protection against discrimination, the right to fair labour standards and the right to a democratic workplace.* *Part III of the Act provides provisions safeguarding employees to unfair labour practices and Part IV provides the general conditions of employment (viz. dismissal, retrenchment, wages, sick leave, death, maternity leave etc.).* *The ESIA and associated ESMP for the Kariba Dam Rehabilitation Project makes provision for the*

Component	Applicable Legislative Instrument	Description of Legislative Instrument
		rights of employees.
Public Participation	• *General Laws Amendment No. 5 of 2011 (Section 12, paragraph H)*	*Paragraph h stipulates that results from the public participation process needs to be disclosed.*

4.2.3 *Zimbabwean Development Policies*

The national development policies for Zimbabwe that potentially applicable to the Project are briefly outlined below.

Zimbabwe Agenda for Sustainable Socio-economic Transformation

In pursuit of a new trajectory of accelerated economic growth and wealth creation, Government has formulated a new plan known as the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (Zim Asset): October 2013-December 2018.

Zim Asset was crafted to achieve sustainable development and social equity anchored on indigenisation, empowerment and employment creation which will be largely propelled by the judicious exploitation of the country's abundant human and natural resources.

This Results Based Agenda is built around four strategic clusters that will enable Zimbabwe to achieve economic growth and reposition the country as one of the strongest economies in the region and Africa. The four strategic clusters identified are: Food Security and Nutrition; Social Services and Poverty Eradication; Infrastructure and Utilities; and Value Addition and Beneficiation [(1)].

Zimbabwean Industrial Development Policy (2012-2016)

The policy's vision is to transform Zimbabwe from a producer of primary goods into a producer of processed value-added goods for both the domestic and export market. The policy mission statement is to create a vibrant, self-sustaining and competitive economy through promotion of viable industrial and commercial sectors as well as domestic and international trade.

The objectives of the policy include:

- The overall objective is to restore the manufacturing sector's contribution to the GDP of Zimbabwe from the current 15% to 30% and its contribution to exports from 26% to 50% by 2015. An average real GDP growth of 15% is targeted under this Policy Framework of 2011-2015.

- To create additional employment in the manufacturing sector on an incremental basis as compared to the previous planning period of 2004 to 2010.

- To increase capacity utilisation from the current levels of around 43% to 100% by the end of the planning period.

- To re-equip and replace obsolete machinery and new technologies for import substitution and enhanced value addition.

(1) http://www.un.int/wcm/webdav/site/zimbabwe/shared/documents/press/Zim-Asset.pdf

- To increase the manufactured exports to the SADC and COMESA regions and the rest of the world.

- To promote utilisation of available local raw materials in the production of goods.

Zimbabwe's National Energy Policy

The National Energy Policy (NEP) seeks to promote the optimal supply and utilisation of energy, for socio-economic development in a safe, sustainable and environmentally friendly manner.

The NEP is intended to fulfil Government's objective of ensuring that the energy sector's potential to drive economic growth and reduce poverty is fully harnessed. The policy therefore provides a guide to decision-makers, policy-makers and development managers in Government, the private sector, Non-Governmental Organisations and civil society, on Government's intended actions in the energy sector.

The policy recognises that regional cooperation is essential for the development of large-scale hydropower resources and that small-scale hydropower projects may not make a significant impact on national requirements but they help to develop skills and to speed up access for remote communities that are not likely to be connected to the national grid in the foreseeable future.

The policy also makes specific reference to the Zimbabwe Energy Regulatory Authority (ZERA) and states that the Authority is expected to create an enabling environment and establish fair play in the energy sector through licensing regulations, product and service standards and investment promotion.

Applicability to Project

These policies have been taken into account during the development of the ESIA and ESMP for the proposed Kariba Dam Rehabilitation Project, specifically during the development of social and environmental mitigation/management commitments. More specifically, the principal of sustainable socio-economic development was the underlying theme for the development of socio-economic mitigation/management measures, particularly for measures that aim towards the creation of employment opportunities and skills development in the local areas and support of local businesses.

The rehabilitation of the Kariba Dam will ensure long-term continuation of the Southern and Northern bank Hydro Power Projects, which in turn will aid the objective set out in the Zimbabwe Industrial Development Policy (2012-2016) and Zimbabwe National Energy Policy.

4.3 ZAMBEZI RIVER AUTHORITY

The Zambezi River Authority (ZRA) is mandated by the governments of Zambia and Zimbabwe to operate and maintain the infrastructure on the Zambezi River.

The ZRA is a statutory body jointly owned by the governments of Zambia and Zimbabwe. The ZRA was established on 1 October 1987 as a result of parallel legislation tabled before the parliaments of the Republics of Zambia and Zimbabwe, which followed the reconstitution of its predecessor, the Central African Power Corporation (CAPCO). Generating assets on the Zambezi River were subsequently handed over to the two national power utilities, the then Zambia Electricity Supply Corporation, now ZESCO Limited (ZESCO) and the then Zimbabwe Electricity Supply Authority now represented by Zimbabwe Power Company (ZPC). The ZRA has responsibility of the operation and maintenance of infrastructure on the Zambezi River (which is common to both Zambia and Zimbabwe), investigation and development of new dam sites on the Zambezi River and collecting, processing, analysing and disseminating hydrological and environmental information pertaining to the Zambezi River and Lake Kariba.

The ZRA is governed by a Council of Ministers consisting of four members from Zambia and Zimbabwe. The common Ministries in the council are those responsible for Energy and Finance. In terms of the Zambezi River Authority Acts, the Council of Ministers gives direction, through the ZRA Board of Directors, to the ZRA to ensure the most efficient use of the Zambezi River and any other infrastructure developed on it.

The ZRA has the following four main strategic functions, which are outlined in the schedule to the Zambezi River Authority Acts Nos. 17 and 19 of 1987 of Zambia and Zimbabwe, respectively:

'1. *In consultation with the national electricity undertakings investigate the desirability of constructing new dams on the Zambezi River and make recommendations thereon to the Council;*
2. *Subject to the approval of the Council, construct, operate, monitor and maintain any other dams on the Zambezi River;*
3. *Make such recommendations to the Council as will ensure the effective and efficient use of waters and other resources of the Zambezi River; and,*
4. *Submit development plans and programmes to the Council for approval.*'

4.4 INTERNATIONAL TREATIES, CONVENTIONS AND PROTOCOLS

Zambia and Zimbabwe are signatories to a number of international conventions and agreements relating to industry, environmental management and energy. In certain cases these have influenced policy, guidelines and regulations. These conventions must be complied with during the planning, construction and operations phases of the proposed development.

Table 4.33 lists the relevant international conventions and protocols to which Zambia or Zimbabwe is a signatory.

Table 4.3 ***Ratification of International Conventions***

Name of Convention	Date of enactment and status
Protocol on Shared Watercourses in the Southern African Development Community (SADC) The overall objective of this Protocol is to foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses and advance the SADC agenda of regional integration and poverty alleviation.	*07/08/2000*
The Basel Convention on Trans-boundary Movement of Hazardous Waste The Basel Convention governs the generation, collection, storage, transportation, pre-treatment, treatment, disposal, export, import and trans-boundary movement of hazardous waste.	*Zambia: 15/11/1994 (Accession)* *Zimbabwe: 01/03/2012 (Accession)*
Bamako Convention on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa *The Bamako Convention uses a format and language similar to that of the Basel Convention, but is much stronger in prohibiting all imports of hazardous waste. Additionally, it does not make exceptions on certain hazardous wastes (like those for radioactive materials) made by the Basel Convention.*	*Zambia: 03/08/2005 (signed)* *Zimbabwe: 10/07/1992 (ratified)*
The Convention Concerning the Protection of the World's Cultural and Natural Heritage The Convention provides for the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage which are of outstanding universal value from the point of view of history, art or science.	*Zambia: 04/06/1984 (ratified)* *Zimbabwe: 16/08/1982 (ratified)*
***Convention on International Trade in Endangered Species** of Wild Fauna and Flora (**CITES**)* CITES is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	***Zambia: 24/11/1980 (ratified)*** ***Zimbabwe: 19/05/1981 (ratified)***
International Union for the Conservation of Nature and Natural Resources (IUCN) Encourages the preservation of wildlife, natural environments, and living resources and promotes research in the preservation of threatened species, ecology, sustainable development, and environmental law, education, and training.	*Zambia: member* *Zimbabwe: member*

Name of Convention	Date of enactment and status
African Convention on the Conservation of Nature and Natural Resources Recognises the need to contribute to the conservation of nature and natural resources at a continent level.	*Zambia: signatory* *Zimbabwe: signatory*
United Nation Convention to Combat Desertification (UNCCD) Recognises the need to control any form of desertification that may arise as a result of anthropogenic activities. The statutes of the UNCCD, encourages the control of desertification as a result of man's activities.	*Zambia: 19/09/1996 (ratified)* *Zimbabwe: 1997 (ratified)*
United Nations Framework Convention on Climate Change (UNFCCC) UNFCCC is an international agreement for the control of climate change.	*Zambia: 28 May 1993 (ratified)* *Zimbabwe: 3/10/1992 (ratified)*
The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) An international treaty that sets binding obligations on industrialized countries to reduce emissions of greenhouse gases. The UNFCCC is an environmental treaty with the goal of preventing dangerous anthropogenic (i.e., human-induced) interference of the climate system.	*Zambia: 07/07/2006 (ratified)* *Zimbabwe: 30/06/2009 (ratified)*
Convention concerning the Abolition of Forced Labour, 1957 (ILO) Cancels certain forms of forced labour still allowed under the Forced Labour Convention of 1930, such as punishment for strikes and as a punishment for holding certain political views.	*Zambia: 22/02/1965 (ratified)* *Zimbabwe: 27/08/1998 (ratified)*
Convention concerning Discrimination in Respect of Employment and Occupation or Discrimination (Employment and Occupation) Convention (ILO) The convention requires states to enable legislation which prohibits all discrimination and exclusion on any basis including of race or colour, sex, religion, political opinion, national or social origin in employment and repeal legislation that is not based on equal opportunities.	*Zambia: 23/10/1979 (ratified)* *Zimbabwe: 23/06/1999 (ratified)*
African Charter on Human and Peoples' Rights Is an international human rights instrument that is intended to promote and protect human rights and basic freedoms in the African continent.	*Zambia: 10/01/1984 (ratified)* *Zimbabwe: 30/05/1986 (ratified)*
Convention Concerning the Protection of Workers against Occupational Hazards in Working Environments due to Air Pollution and Noise Vibrations Recognises the need to protect workers against hazards in working environments.	*Zambia: 19/08/ 1980 (ratified)* *Zimbabwe: not a member*

Name of Convention	Date of enactment and status
Agreement on Co-operative Enforcement Operations directed at Illegal Trade in Wild Fauna and Flora The objective of this Agreement is to reduce and ultimately eliminate illegal trade in wild fauna and flora and to establish a permanent Task Force for this purpose.	*Zambia: 9/11/1995 (ratified)* *Zimbabwe: not a member*
Agreement on the Action Plan for the Environmentally Sound Management of the Common Zambezi River System Is an agreement aiming to develop regional co-operation on environmentally sound water resources management of the common Zambezi river system and to strengthen regional co-operation for sustainable development.	*Zambia: 28/05/1987 (ratified)* *Zimbabwe: 28/05/1987 (ratified)*
Constitution of the International Labour Organisation A constitution detailing conditions and standards for acceptable labour practices.	*Zambia: (ratified)* *Zimbabwe: (ratified)*
Convention on Biological Diversity The Convention has three main objectives; the conservation of biological diversity, the sustainable use of the components of biological diversity and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	*Zambia: (ratified)* *Zimbabwe: (ratified)*
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar) An international treaty for the conservation and sustainable utilization of wetlands. The treaty recognizes the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.	*Zambia: (ratified)* *Zimbabwe: (ratified)*
International Plant Protection Convection Is an international agreement on plant health which aims to protect cultivated and wild plants by preventing the introduction and spread of pests.	*Zambia: (ratified)* *Zimbabwe: not a member*
Statutes of the International Centre for the Study of the Preservation and restoration of Cultural Property Intergovernmental organisation dedicated to the conservation of cultural heritage. It has a worldwide mandate to promote the conservation of all types of cultural heritage, both movable and immovable.	*Zambia: not a member* *Zimbabwe: ratified*
Statutes of the International Union for Conservation of Nature and Natural Resources (as amended) Intergovernmental organisation with the objective to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.	*Zambia: not a member* *Zimbabwe: ratified*

4.5 *INTERNATIONAL AND REGIONAL GUIDELINES AND STANDARDS*

There a number of international environmental and social guidelines and standards applicable to the Project, especially with regards to International Finance Institutions (IFIs). These include the following:

- World Bank Safeguard Policies;
- The International Finance Corporation (IFC) Performance Standards;
- World Commission on Dams (WCD) Guidelines and Recommendations; and
- The International Hydropower Association (IHA) Sustainability Guidelines and Sustainability Assessment Protocols.

4.5.1 *World Bank Group Operation Policies*

The World Bank has ten environmental and social "Safeguard Policies" that are used to examine the potential environmental and social risks and benefits associated with World Bank lending operations. These safeguard policies include the following:

1. Environmental Assessment;
2. Natural Habitats;
3. Forestry;
4. Pest Management;
5. Cultural Property;
6. Indigenous Peoples;
7. Involuntary Resettlement;
8. Safety of Dams;
9. Projects in International Waters; and
10. Projects in Disputed Areas.

The policies of relevance to the Kariba Rehabilitation Works are summarised below:

Environmental Assessment

Operational Procedure 4.01 Environmental Assessment (EA) evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimising, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

Natural Habitats

Operational Policy 4.04 Natural Habitats promotes the conservation of natural habitats. The World Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats. The Bank encourages borrowers to incorporate analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, and priorities for conservation. The Bank also expects the borrower to take into account the views, roles, and rights of groups, including local non-governmental organizations and local communities, affected by any project involving natural habitats, and to involve such people in planning, designing, implementing, monitoring, and evaluating such projects.

Forestry

Operational Policy 4.36 – Forests, involves the management, conservation, and sustainable development of forest ecosystems and their associated resources to ensure lasting poverty reduction and sustainable development, whether located in countries with abundant forests or in those with depleted or naturally limited forest resources. The objective of this policy is to assist borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests. In accordance with *operational procedure 4.01, Environmental Assessment*, the environmental assessment (EA) must address the potential impact of the project on forests.

Cultural Property

Operational Policy 4.11 – Cultural Property addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. Any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes are to take cognisance of this policy in the EA.

Involuntary Resettlement

The World Bank's *Operational Policy 4.12: Involuntary Resettlement* is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimise and mitigate its adverse social and economic impacts. In the event that involuntary resettlement is triggered, the Policy requires the task team and developer to:

- Assess the nature and magnitude of the likely displacement;

- Explore all viable alternative project designs to avoid, where feasible, or minimize displacement;

- Assess the legal framework covering resettlement and the policies of the government and implementing agencies (identifying any inconsistencies between such policies and the Bank's policy);

- Review past borrower and likely implementing agencies' experience with similar operations;

- Discuss with the agencies responsible for resettlement the policies and institutional, legal, and consultative arrangements for resettlement, including measures to address any inconsistencies between government or implementing agency policies and Bank policy; and

- Discuss any technical assistance to be provided to the borrower.

The policy also promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement. The policy also prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.

Safety of Dams

Operational Policy 4.37: Safety on Dams requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures through the project cycle. The policy also applies to existing dams where they influence the performance of a project. The policy also recommends, where appropriate, that Bank staff discuss with the borrowers any measures necessary to strengthen the institutional, legislative, and regulatory frameworks for dam safety programs in those countries.

Projects on International Waterways

Operational Policy 7.50: International Waterways applies to any river or body of surface water that flows through, two or more states, whether these states are World Bank members or not. This policy applies to irrigation systems, dams and flood control measures. If such a project is proposed, the World Bank requires the beneficiary state to formally notify the other riparians states of the project and its Project Details. OP 7.50 is triggered by the Kariba Rehabilitation Works Project and according to the ZRA notification has been made in accordance with provisions of Southern African Development Community (SADC) Protocol / Zambezi Watercourse Commission (ZAMCOM) Agreement and meeting the requirements of OP 7.50.

4.5.2 *The International Finance Corporation*

Performance Standards

The International Finance Corporation (IFC), a division of the World Bank Group that lends to private investors, has released a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability (January 2012) (see *Box 4.1*).

Box 4.1 ***Performance Standards on Social and Environmental Sustainability***

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

These Standards are used to evaluate any project seeking funding through the IFC. The Equator Principles[1] which reflect the application by major international banking institutions of IFC-inspired environmental and social best practice guidelines in the financing of large projects have been revised to adhere to the new IFC Performance Standards. However, the Equator Principles Financial Institutions (EPFIs) do not use the IFC's Sustainability or Disclosure Policy, as these were not adopted by the banks. The EPFIs have their own sustainability and disclosure policies, and take the same approach, e.g. the borrower's/client's project must comply with the Performance Standards and the applicable Environment, Health and Safety (EHS) Guidelines.

The Performance Standards underscore the importance of managing environmental, social and health issues throughout the life of a project. They identify the need for an effective social and environmental management system that is dynamic and continuous, '*involving communication between the client, its workers, and the local communities directly affected by the Project*'. They require '*thorough assessment of potential social and environmental impacts and risks from the early stages of project development and provides order and consistency for mitigating and managing these on an ongoing basis*'. [2] Through the Performance Standards, the IFC also requires that clients engage with affected communities through disclosure of information, consultation, and informed participation,

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(1) The Equator Principles are a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing. As of 01/01/2011, they had been adopted by 70 major banking institutions. The Equator Principles reflect a common set of international, IFC-inspired best practices guidelines to manage social and environmental risks related to the financing of large projects.
(2) IFC, 2006.

in a manner commensurate with the risks to, and impacts on, the affected communities.

The IFC Performance Standards, and each of their objectives, are outlined in *Table 4.4*.

Table 4.4 International Finance Corporation (IFC) Performance Standards

Performance Standards	Objectives
Assessment and Management of Environmental and Social Risks and Impacts Performance Standard 1 underscores the importance of managing social and environmental performance throughout the life of a project (any business activity that is subject to assessment and management).	• To identify and evaluate environmental and social risks and impacts of the project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. • To promote improved environmental and social performance of clients through the effective use of management systems. • To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.
Labour and Working Conditions Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.	• To promote the fair treatment, non-discrimination, and equal opportunity of workers. • To establish, maintain, and improve the worker-management relationship. • To promote compliance with national employment and labor laws. • To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. • To promote safe and healthy working conditions, and the health of workers. • To avoid the use of forced labor.
Resource Efficiency and Pollution Prevention Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.	• To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions.
Community Health, Safety and Security Performance Standard 4 recognizes that project activities, equipment, and infrastructure often bring benefits to	• To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.

Performance Standards	Objectives
communities including employment, services, and opportunities for economic development.	• To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.
Land Acquisition and Involuntary Resettlement **Performance Standard 5** outlines that involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition	• To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. • To avoid forced eviction. • To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost4 and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
Biodiversity Conservation and Sustainable Management of Living Natural Resources Performance Standard 6 recognizes that protecting and conserving biodiversity (the variety of life in all its forms, including genetic, species and ecosystem diversity) and its ability to change and evolve, is fundamental to sustainable development	• To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.
Indigenous Peoples **Performance Standard 7** recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population.	• To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. • To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. • To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. • To respect and preserve the culture,

Performance Standards	Objectives
	knowledge, and practices of Indigenous Peoples.
Cultural Heritage **Performance Standard 8** recognises the importance of cultural heritage for current and future generations	• To protect cultural heritage from the adverse impacts of project activities and support its preservation. • To promote the equitable sharing of benefits from the use of cultural heritage.

4.5.3 *IFC Environmental, Health and Safety (EHS) Guidelines*

The EHS Guidelines are technical reference documents which address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

When the regulations of a host country (Zambia and/ or Zimbabwe) differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

General EHS Guidelines also exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors, as listed in *Box 4.2.*

Box 4.2 *IFC General EHS Guidelines*

General EHS Guidelines

1. Environmental

1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise
1.8 Contaminated Land

2. Occupational Health and Safety

2.1 General Facility Design and Operation
2.2 Communication and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazard Environments
2.9 Monitoring

3. Community Health and Safety

3.1 Water Quality and Availability
3.2 Structural Safety of Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response

4. Construction and Decommissioning

4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety

4.5.4 *African Development Bank Group's Integrated Safeguards System and Operational Safeguards* (1)

The African Development Bank (AfDB) adopted its Environmental Policy in 1990, a set of Environmental and Social Assessment Procedures (ESAPs) in 2001, the Involuntary Resettlement Policy in 2003 and a revised Policy on the Environment in 2004. These previous policies provided the basis for the AfDB's current environmental and social safeguards, which set out the requirements for an appropriate level of environmental and social assessment and management measures to mitigate project-related risks.

The AfDB has further cross-cutting and sector policies that contain commitments to promote environmental and social sustainability in AfDB operations: policies on health (1996), integrated water resources management

(1) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1

(2000), agriculture and rural development (2000), gender (2001), co-operation with civil society organisations (2001), involuntary resettlement (2003), poverty reduction (2004), and the environment (2004), as well as the Civil Society Engagement Framework (2012).

The AfDB has developed an Integrated Safeguards System (ISS) to update its safeguards policies and consolidate them into a set of Operational Safeguards (OSs) supported by revised ESAPs and Integrated Environmental and Social Impact Assessment (IESIA) Guidance Notes. The ISS supersedes the provisions in previous policies on environmental and social safeguards and compliance aspects.

As the Kariba Rehabilitation Works Project is being co-funded by the African Development Bank, the relevant Operational Safeguards will need to be complied with by the Project. The African Development Bank Operational Safeguards and each of their objectives, are outlined in*Table 4.5*.

Table 4.5 African Development Bank Operational Safeguards

Performance Standards	Objectives
Operational safeguard 1 – Environmental and social assessment	Overall objective is to mainstream environmental and social considerations— including those related to climate change vulnerability—into AfDB operations and thereby contribute to sustainable development in the region. The specific objectives are to (1) : • *'Mainstream environmental, climate change, and social considerations into Country Strategy Papers (CSPs) and Regional Integration Strategy Papers (RISPs);* • *Identify and assess the environmental and social impacts and risks—including those related to gender, climate change and vulnerability—of Bank lending and grant-financed operations in their areas of influence;* • *Avoid or, if avoidance is not possible, minimise, mitigate and compensate for adverse impacts on the environment and on affected communities;* • *Provide for stakeholders' participation during the consultation process so that affected communities and stakeholders have timely access to information in suitable forms about Bank operations, and are consulted meaningfully about issues that may affect them;* • *Ensure the effective management of environmental and social risks in projects during and after implementation; and* • *Contribute to strengthening regional member country (RMC) systems for environmental and social risk management by assessing and building their capacity to meet AfDB requirements set out in the Integrated Safeguards System (ISS).'*
Operational safeguard 2 – Involuntary resettlement: land acquisition, population displacement and compensation	This Operational Safeguard (OS) aims to facilitate the operationalization of the AfDB's 2003 Involuntary Resettlement Policy in the context of the requirements of OS1 and thereby mainstream resettlement considerations into Bank operations. Specific objectives of this OS mirror the objectives of the involuntary resettlement policy to (2) : • *'Avoid involuntary resettlement where feasible, or minimize resettlement impacts where involuntary resettlement is deemed unavoidable after all alternative project designs have been explored;* • *Ensure that displaced people are meaningfully consulted and given opportunities to participate in the planning and implementation of resettlement programmes;* • *Ensure that displaced people receive significant resettlement assistance under the project, so that their standards of living, income-earning capacity, production levels and overall means of livelihood are improved beyond pre-project levels;* • *Provide explicit guidance to borrowers on the conditions that need to be met regarding involuntary resettlement issues in AfDB operations to mitigate the negative impacts of displacement and resettlement, actively facilitate social development and establish a sustainable economy and society; and* • *Guard against poorly prepared and implemented resettlement plans by setting up a mechanism for monitoring the performance of involuntary resettlement programmes in Bank operations and remedying problems as they arise.'*

(1) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1.

(2) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1.

Performance Standards	Objectives
Operational safeguard 3 – Biodiversity, renewable resources and ecosystem services	This OS outlines the requirements for borrowers or clients to (i) identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats, and (ii) observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services. The OS reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote the sustainable management and use of natural resources. It also aligns with the Ramsar Convention on Wetlands, the Convention on the Conservation of Migratory Species of Wild Animals, the Convention on International Trade in Endangered Species of Wild Flora and Fauna, the World Heritage Convention, the UN Convention to Combat Desertification and the Millennium Ecosystem Assessment. The OS's recommendations also align with the International Plant Protection Convention. The specific objectives of the OS are to (1) : • '*Conserve biological diversity and ecosystem integrity by avoiding or, if avoidance is not possible, reducing and minimising potentially harmful impacts on biodiversity;* • *Endeavour to reinstate or restore biodiversity, including, where some impacts are unavoidable, through implementing biodiversity offsets to achieve "not net loss but net gain" of biodiversity;* • *Protect natural, modified, and critical habitats; and* • *Sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and sustain project performance.*'
Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency	This OS outlines the main pollution prevention and control requirements for borrowers or clients to achieve high-quality environmental performance, and efficient and sustainable use of natural resources, over the life of a project. The specific objectives are to (2) : • '*Manage and reduce pollutants resulting from the project – including hazardous and nonhazardous waste – so that they do not pose harmful risks to human health and the environment; and* • *Set a framework for efficiently using all of a project's raw materials and natural resources, especially energy and water.*' This OS aligns AfDB operations with existing international conventions and standards related to pollution, hazardous materials and waste, and related issues. I t al s o requires compliance with internationally accepted environmental standards, particularly the World Bank Group Environmental Health and Safety (EHS) Guidelines.

(1) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1.
(2) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1.

Performance Standards	Objectives
Operational safeguard 5 – Labour conditions, health and safety	This OS outlines the main requirements for borrowers or clients to protect the rights of workers and provide for their basic needs. The specific objectives are to [1] : • *'Protect workers' rights;* • *Establish, maintain, and improve the employee–employer relationship;* • *Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent or inconsistent with the OS;* • *Align Bank requirements with the ILO Core Labor Standards, and the UNICEF Convention on the Rights of the Child, where national laws do not provide equivalent protection;* • *Protect the workforce from inequality, social exclusion, child labour, and forced labour; and* • *Establish requirements to provide safe and healthy working conditions.'*

4.5.5 World Commission on Dams

The World Commission on Dams (WCD) was established in May 1998 in response to the escalating local and international controversies over large dams, with the mandate to:

i) Review the development effectiveness of large dams and assess alternatives for water resources and energy development; and

ii) Develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams. [2]

The WCD framework puts forward seven strategic priorities which are widely acknowledged as a framework for dialogue (see *Table 4.6*). These seven strategic priorities are each based on a set of policy principles. A set of 26 guidelines for good practice lay out specific actions for complying with the strategic priorities at five key stages of the project development process.

Table 4.6 World Commission on Dams Strategic Priorities

Strategic Priority 1 - Gaining Public Acceptance
In order to develop water and energy resources in an equitable and sustainable manner, it is essential that there is public acceptance of such initiatives. This entails recognising the rights, addressing the risks and safeguarding the entitlements of all interested groups, by ensuring that they are informed about the issues at stake, able effectively to participate in decision-making processes, and that there is demonstrable acceptance of key decisions. Particular care should be taken to include the most vulnerable parties, such as women, the poor and certain indigenous groups, and that decision-making processes are guided by their free, informed and prior consent.
Strategic Priority 2 - Comprehensive Options Assessment
The most appropriate development initiatives for a particular area can only be identified by assessing food, water and energy needs and clearly defining programme objectives. The full range of policy, institutional and technical options, which may well include alternatives to dams, should then be comprehensively assessed in a participatory process that accords the

(1) African Development Bank. 2013. Safeguards and Sustainability Series Volume 1 - Issue 1.
(2) World Commission on Dams (2000a)

same significance to social and environmental considerations as to economic and financial factors. This process of assessment should continue throughout the planning, development and implementation of the project.

Strategic Priority 3 - Addressing Existing Dams

Dams and the context in which they operate are not static over time. Their benefits and impacts may be transformed by changes in priorities for water use, physical and land use changes in the river basin, technological developments, and changes in public policy expressed in environmental, safety, economic and technical regulations. Management and operational practices should be continuously assessed and adapted to changing circumstances, in order to optimise the benefits, address social issues and improve measures to limit and restore damage to the environment. This process should extend beyond the life of the project, so that the performance, benefits and impacts of all existing large dams can be monitored and evaluated on a long-term basis, and appropriate action taken to improve all aspects of their service delivery.

Strategic Priority 4 - Sustaining Rivers and Livelihoods

Dams transform the landscapes they inhabit, with potentially irreversible effect. It is essential to understand, protect and restore ecosystems at river basin level, in order to minimise their negative impact, limit and mitigate harm to the health and integrity of the river system and those dependent upon it, and promote equitable human development and the welfare of all species. These are key issues when selecting sites and designing projects. Governments should develop national policies for maintaining in their natural state selected rivers with high ecosystem functions and values, and look for alternative sites on tributaries when assessing proposals for dams on undeveloped rivers.

Strategic Priority 5 - Recognizing Entitlements and Sharing Benefits

Rather than benefiting from them, many of those affected by dams are aware only of their negative impacts. To redress the balance, a process of joint negotiation with such groups is required, based on recognition of rights and assessment of risks. The aim of these negotiations is to agree on legally enforceable mitigation and development provisions, which recognise entitlements that improve livelihoods and quality of life. States and developers are responsible for resettling and compensating all affected people, and satisfying them that their livelihoods will be improved by moving from their current situation. Legal means, such as contracts and accessible recourse at national and international levels, should be used to ensure that responsible parties fulfil their commitments to agreed mitigation, resettlement and development provisions.

Strategic Priority 6 - Ensuring Compliance

In order to win and maintain public trust and confidence, governments, developers, regulators and operators must meet their commitments for planning, implementing and operating dams. Compliance with applicable regulations, criteria and guidelines, and project-specific negotiated agreements should be ensured at all critical stages of project planning and implementation. A set of regulatory and non-regulatory mechanisms, incorporating incentives and sanctions, and flexible enough to accommodate changing circumstances, is needed to enforce social, environmental and technical measures. A clear, consistent and common set of criteria and guidelines to ensure compliance should be adopted by sponsoring, contracting and financing institutions, and compliance subjected to independent and transparent review. Legislation, voluntary integrity pacts, debarments and other instruments should be used to eliminate corrupt practices.

Strategic Priority 7 - Sharing Rivers for Peace, Development and Security

The storage and diversion of water on transboundary rivers can cause considerable tension within and between countries. As specific interventions for diverting water, dams require constructive co-operation, and states or political units within countries need to agree on the use of resources in order to promote regional co-operation and peaceful collaboration. Rather than focusing on allocating water as a finite resource, states need to work on sharing rivers and their associated benefits. This will involve negotiating a wide range of issues, and making provision in national water policies for basin agreements in shared river basins. These agreements should be based on the principles of equitable and reasonable use, no significant harm, prior information and the Commission's strategic priorities.

If an objection by a riparian state to a proposal for a new dam on a shared river is upheld by an independent panel, construction should not be carried out. Furthermore, where a government agency plans the construction of a dam on a shared river in contravention of the principle of good faith negotiations between riparians, external financing bodies should withdraw their support for projects and programmes promoted by that agency.

Source: World Commission on Dams (2001)

The WCD dissolved in 2001 having undertaken its assigned activities. The WCD framework, however, has become a key benchmark in international dam building. The World Bank, export credit agencies and the International Hydropower Association, while critical of specific recommendations, have endorsed the WCD's strategic priorities.

4.5.6 International Hydropower Association (IHA) Sustainability Guidelines

The IHA Sustainability Guidelines (SGs) were published in February 2004, with the aim of promoting greater consideration of environmental, social, and economic sustainability in the assessment of:

- New energy projects;
- New hydropower projects; and
- The management and operation of existing hydropower facilities.

The principles set out in the SGs encompass a number of elements, which include:

- The role of governments;
- The decision making processes;
- Hydropower - environmental aspects of sustainability;
- Hydropower - social aspects of sustainability; and
- Hydropower - economic aspects of sustainability.

The IHA has put forward policy and sustainability criteria which encourage good governance within each country and collaboration between governments at an international level to ensure sustainable hydropower development prerequisites are met. According to the IHA, it is the responsibility of governments to:

- Have in place national and/or regional energy policies, which should:
  - Clearly set out energy development strategies;
  - Include a Strategic Assessment (SA) process that involves an assessment of cumulative impacts, determination of land use and environmental priorities, as well as goals for poverty alleviation and economic growth;
  - Be framed in the context of the global need to reduce greenhouse emissions;

- Incorporate the three elements of sustainability -- economic, social and environmental -- in energy planning; and

- Be a participatory, streamlined process, focused on major issues, using common sense and readily available information, and with short and definite time limits for its completion.

• Evaluate alternative energy options using key sustainability criteria, prescribed by the IHA; and

• Evaluate hydropower project alternatives using key sustainability criteria, prescribed by the IHA.

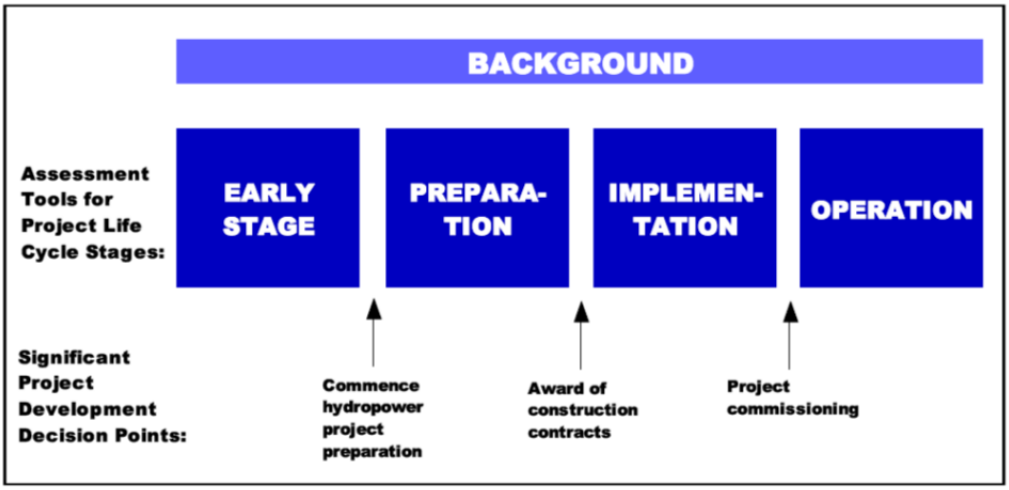
In order to facilitate decision making and to ensure the sustainability of hydropower projects, the IHA's policy position is that Environmental Assessments (EAs) should be applied at the project level from the pre-feasibility stage to the post-construction auditing stage. The IHA encourages governments and project proponents, through the use of key criteria, to ensure appropriate management of environmental and social issues throughout the life of the project by adopting strategies to maximise positive outcomes and reduce the severity or avoidance of negative social, economic and environmental impacts.

To support the IHA SGs, the IHA has also developed the Hydropower Sustainability Assessment Protocol, which was released in 2006 and updated in November 2010, to assist in assessing performance against the criteria set out in the IHA SGs.

4.5.7 *Hydropower Sustainability Assessment Protocol*

The IHA Hydropower Sustainability Assessment Protocol (the Protocol) is a sustainability assessment framework for hydropower development and operation. The intention of the Protocol is to enable the production of a sustainability profile for hydropower projects through the assessment of performance against sustainability topics. In particular, the Protocol comprises four assessment tools for the different stages of the project life cycle, as shown in *Figure 4.2*.

Figure 4.2 Protocol Assessment Tools and Major Decision Points



These four assessment tools – Early Stage, Preparation, Implementation, and Operation, are designed to be stand-alone assessments applied at particular stages of the hydropower project life cycle.

The **Early Stage** assessment tool is a preliminary screening tool to assess the strategic environment from which proposals for hydropower projects emerge. It identifies project risks and opportunities at an early stage, in order to identify the challenges and management responses to proceed with a more detailed project investigation.

The **Preparation** assessment tool assesses the preparation stage of a hydropower project, during which investigations, planning and design are undertaken for all aspects of the project. This project stage is normally subject to national regulatory processes regarding project-specific Environmental and Social Impact Assessment (ESIA) requirements as well as project management processes.

The **Implementation** assessment tool assesses the implementation stage of a hydropower project, during which construction, resettlement, environmental and other management plans and commitments are implemented.

The **Operation** assessment tool assesses the operation of a hydropower facility. This Protocol assessment tool can be used to inform the view that the facility is operating on a sustainable basis with active measures in place towards monitoring, compliance and continuous improvement.

Each assessment tool includes a list of topics, which when taken together, provide a list of issues that must be considered to confidently form a view on the overall sustainability of a hydropower project at a particular point in its life cycle. Within each topic, criteria are utilised for the scoring of each topic, these criteria include:

1. Assessment;
2. Management;
3. Stakeholder Engagement;
4. Stakeholder Support;
5. Conformance/Compliance; and
6. Outcomes.

These criteria allow the assessment of both the processes in place to ensure sustainability of the project or operation, and the performance of that project or operation on that particular sustainability topic.

4.5.8 *The Southern African Power Pool (SAPP) Environmental and Social Impact Assessment Guidelines for Hydroelectric Projects and Transmission Infrastructure in the SAPP region* (1)

The Southern African Power Pool (SAPP)

The SAPP is a regional body formed in 1995 through a Southern African Development Community (SADC) treaty, with the objective of optimizing the use of available energy resources in the region and for SADC members to support one another during energy emergencies. The SAPP coordination centre is based in Harare, Zimbabwe. There are four governance documents covering the rights and obligations of the SAPP members. These are:

'*i. Inter-governmental Memorandum of understanding (IGMOU), which grants permission for utilities to participate in the SAPP and enter into contracts and guarantees the financial and technical performance of the power utilities;*
ii. Inter-utility memorandum of understanding (IUMOU) between parties, defining ownership of assets and other rights, e.g. provision for change in status from participating to operating member;
iii. Agreement between operating members (ABOM), which determines the interaction between the utilities with respect to operating responsibilities under normal or emergency conditions;
iv. Operating guidelines (OG), which defines the sharing of costs and functional responsibility for plant operation and maintenance including safety rules.'

The SAPP has the following vision.

- '*Facilitate the development of a competitive electricity market in the SADC region*
- *Give the end user a choice of electricity supplier*
- *Ensure that the southern Africa is the region for choice for investment by intensive energy users*
- *Ensure sustainable energy developments through sound economic, environmental and social practices.*'

Further top the SAPP vision, the SAPP has the following objectives.

(1) Environmental and Social Impact Assessment Guidelines for Transmission Infrastructure for the SAPP Region,2010.

- *'To provide a forum for the development of a world class, robust, safe, efficient, reliable and stable interconnected electricity system in the southern African region*
- *Coordinate and enforce common regional standards of quality of supply, measurement and monitoring of systems performance*
- *Harmonise the relationship between member utilities*
- *Facilitate the development of a regional expertise through training programmes and research*
- *Increase power accessibility in rural communities*
- *Implement strategies in support of sustainable development priorities'*

Purpose of the SAPP ESIA Guidelines

The SAPP Environmental Sub-committee identified the need for ESIA guidelines for transmission infrastructure as a priority. Further to this the sub-committee also designed ESIA guidelines for thermal; plant and hydro scheme projects. The purpose of these guidelines is to assist stakeholders in Southern Africa participating in or undertaking ESIAs. SAPP guidelines recognise the need for a more streamlined ESIA process and improved co-ordination amongst SAPP members. It is noted that the SAPP guidelines are not intended to replace either the international funding requirements or the individual country's legislation with regard to ESIA requirements. The SAPP guidelines purpose is to supplement these mandates, or to provide guidelines in the absence of country legislation pertaining to a specific issue related to transmission infrastructure.

SAPP Goals, Objectives and Guiding Principles

The overall goal of the SAPP guidelines is to promote environmentally sustainable livelihoods and development.

The long-term objectives include:

- *'Conservation and sustainable use of natural resources,*
- *Protection and enhancement of the quality of all forms of life,*
- *Promotion of public awareness on environmental issues,*
- *Strengthening and building capacities to carry out ESIA,*
- *Integration of environmental considerations in development planning process,*
- *Generation, storage, and dissemination of environmental information, and*
- *Linking grassroots development strategies to global and international initiatives.*
- *To improve the efficiency of electrical systems, by minimising the interaction between the infrastructure and the environment'*

The short-term objectives (project specific) include:

- *'To assess the nature, intensity and duration of impacts, positive and / or negative, to proposed development projects,*
- *To assist in decision-making with regard to costs and benefits of proposed development projects,*
- *To promote local community and public participation in the ESIA process, and*

- *To promote social and cultural considerations in project design*.'

The guiding principles include:

- *'Adoption of appropriate policies and legislation to guide the ESIA process,*
- *All development projects to be subjected to the ESIA process,*
- *Equity in allocation of and access to resources, poverty alleviation, and promotion of social justice,*
- *Popular participation of all affected and interested parties including grassroots communities, in the ESIA process,*
- *Accountability of all participating parties to the public,*
- *Transparency throughout the ESIA process,*
- *The ESIA process to take special consideration of the role played by women and children in resource management and any impacts on these groups,*
- *The ESIA process to be a tool in the promotion of sustainable livelihoods and sustainable living*.'

The guidelines provide further guidance on the ESIA process to be undertaken, specifically regarding the components and format of an ESIA, and the stakeholder engagement required to be undertaken.

5 *ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) METHODOLOGY*

5.1 *INTRODUCTION*

The purpose of this ESIA is to examine how the Kariba Dam Rehabilitation Project will lead to a measurable difference in the quality of the environment and the quality of life of impacted individuals and communities. Over the past decades, environmental impact assessments have expanded to include social impact assessments as well as public consultation/stakeholder engagement in the planning and decision-making process to avoid, reduce, or mitigate adverse impacts and to maximise the benefits of projects. More recently, the emphasis has moved to the ESIA producing robust social and environmental management plans which can effectively implement the recommended mitigation measures (developed in partnership with the proponent) identified in the ESIA during the life of the project.

The key stages for this ESIA are:

- Scoping;
- Stakeholder engagement;
- Baseline data collection;
- Project description and interaction with design and decision-making bodies;
- Assessment of impacts and identification of mitigation measures;
- Integrated management system and plans; and
- Reporting and disclosure.

It must be noted that the ESIA process is not linear, but one where several stages are carried out in parallel and where the assumptions and conclusions are revisited and modified as the project and ESIA progress.

The following sections provide detail on how each stage of the ESIA process has been applied to the proposed Kariba Dam Rehabilitation Project.

Moreover, this *Chapter* (more specifically *Section 5.4*) provides the methodologies for specialist primary baseline data collection.

5.2 *SCOPING*

The purpose of the scoping phase was to identify key sensitivities and those activities with the potential to contribute to, or cause, potentially significant impacts to environmental and social receptors and resources and to evaluate siting, layout and technology alternatives for the Project proposed. The key objectives of scoping were to:

- Identify the potentially most significant impacts;
- Obtain stakeholder views through consultation; and
- Develop the Terms of Reference (ToR) for the ESIA through consultation so as to ensure that the ESIA process and associated reporting output are focused on the key issues.

The ESIA process focuses on these key issues through the collection of information on existing environmental and social conditions; engagement with stakeholders; understanding the impacts to the physical, biophysical and social environment; and developing the measures to avoid/control and monitor these impacts.

The ToR for the ESIA (the Scoping/Prospectus Report), formed the basis for this ESIA. This Scoping/Prospectus Report fulfilled the Zambian requirements for a Scoping Report and Zimbabwean requirements for a Prospectus report, and has since been approved by the Zambian Environmental Management Agency (ZEMA) on 27 February 2015 (reference number: ZEMA/INS/101/04/1) and the Zimbabwean Environmental Management Agency (EMA) on 02 March 2015 (reference number: 17/1/1/3A) (refer to *Annex A* of *Part II*). Moreover, the approved Scoping/Prospectus report can be referred to in *Annex B* of Part II of this ESIA.

Issues that were raised by stakeholders during the scoping phase were taken into account in the ESIA ToR. A list of these issues is included in the Public Participation Annex (*Annex C* of *Part II*).

5.3 PUBLIC PARTICIPATION

The key principle of consultation is to ensure that the views of stakeholders are taken into account and reported throughout the ESIA process. The objective is to ensure the assessment is robust, transparent and has considered the full range of issues or perceptions, and to an appropriate level of detail.

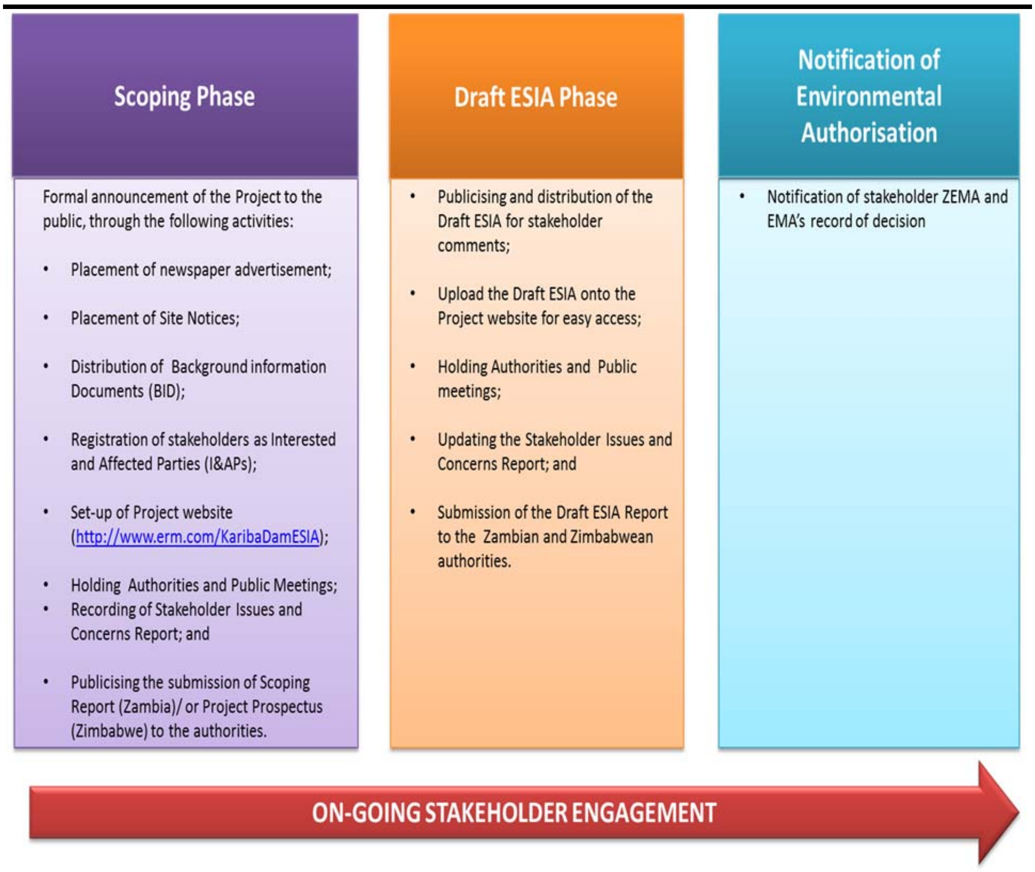
Box 5.1 Definition of Stakeholders

Stakeholders include those individuals, groups or organisations who themselves could be directly affected by the proposed Project (Project affected people) and those individuals or organisations who, although not directly affected by the proposed Project, represent those affected or have a regulatory duty, an interest, influence or secondary involvement in the proposed Project (secondary stakeholders).

Detailed public participation started during the scoping phase and continued throughout the assessment ensuring that legislative requirements and Project standards (as defined in *Chapter 4*) were met, that stakeholder concerns were addressed in the assessment and that sources of existing information and expertise were identified.

The overall public participation process was designed to slot in with typical ESIA Phases; namely Scoping, draft ESIA and announcement of ZEMA and EMA's approval or rejection (i.e., Environmental Authorisation) regarding the Project. The phases and activities planned per phase are shown in *Figure 5.1* below.

Figure 5.1 Public Participation Process



5.3.1 Stakeholder Identification

Stakeholder identification took place through a social scan followed by stakeholder recording and categorization. During the stakeholder identification, individuals, groups and local communities that may be interested and affected by the Project, as well as the broader stakeholders who may be able to influence the outcome of the Project, were identified. Elected and non-elected community representatives and leaders were also identified. Care was taken to consult with vulnerable groups such as the elderly and women during this process.

At present, there are no Chiefs within the Project affected area. In Zimbabwe the complete Project Area is owned by the State and managed by the Zimbabwe National Parks, and is therefore not legally under the any Chiefs jurisdiction. However, this said, the following Chiefs are in close proximity to the proposed Kariba Dam Rehabilitation Project:

- Chief Mola;
- Chief Negande;
- Chief Musambakuruma;
- Chief Nebiri; and
- Chief Nyamhunga

These Chiefs have been provided with a copy of the Non-technical Summary and a cover letter describing the Project and ESIA process being followed.

The ESIA stakeholder database (attached as *Annexure A13*) consists of approximately 600 stakeholders representing the different sectors of society. The stakeholder contact details were captured on an electronic database and categorised. Each stakeholder's attendance of consultation activities were recorded. Key stakeholder groups are listed in *Box 5.2* below.

Box 5.2 Key Stakeholder Categories

Stakeholders were identified in the following categories.

National Government: These stakeholders are of primary national importance to the Project and the ESIA process.

Provincial/Regional/District Government: These stakeholders are of district, regional and local importance to the Project.

Directly Affected Communities: Local level communities will be directly impacted (positive and/or negative) by the Project.

Academic Institutions: These include universities, colleges and research organisations which may have an interest in the Project and may be able to provide useful baseline information related to the culture, history, or environment of the Project area.

Other Interest Groups: These comprise, for example, the media (local, national and international) and political parties/groups as well as religious organisations.

Economic Interest Parties: Organisations, businesses and individuals with a direct commercial interest in the project e.g. selling their services or providing supplies to the Project.

It is anticipated that the stakeholder database is a "live" document that will develop and change during rehabilitation of the Kariba Dam.

5.3.2 *Overview of the Public Participation Process during the Scoping Phase*

During the Scoping Phase, stakeholder consultations were focused on achieving the following outcomes:

- To meet key stakeholders and introduce them to the Project and ESIA process;

- To identify the issues, needs and expectations of the interested and affected stakeholders;

- To provide opportunity for stakeholders to contribute to the debate with their local knowledge and experience;

- To refine the terms of reference of specialist work on the basis of stakeholder comment received;

- To gather issues of concern and through this identify a list of potential impacts;
- To gather primary data informing the social impact assessment;

- To verify that stakeholders' issues and concerns have been captured; and

- To assist ZRA in strengthening its relationships with existing and future stakeholders.

Project Announcement and Consultation

The ESIA public participation team announced the opportunity to participate in the Project widely and via a range of communication methods as described in *Table 5.1* below. Communication with stakeholders (including consultation materials) were usually undertaken in three languages, namely English, Shona (Zimbabwe), and Tonga (and sometimes in Bemba or Nyanja) in Zambia. Local facilitators were used during all community meetings.

Table 5.1 Communication Methods for Engagement

Communication Methods	Objective(s)	Activities
Dedicated Project webpage	• To establish a dedicated ESIA webpage on the ERM website, designed to engage with all affected and interested stakeholders with internet access. • To provide electronic links to available documents such as the Scoping and ESIA Reports and supporting materials, as it becomes available. • To provide a point of contact to stakeholders where they are able to provide comments and ask questions regarding the Project.	Establishment of webpage with address: http://www.erm.com/KaribaDamESIA
Media (newspaper); Site Notices; and Radio Announcements.	• To publish and distribute announcements regarding the proposed Project and ESIA process. • To encourage stakeholders to register as interested and affected parties for the ESIA Process. • To inform stakeholders of scheduled meetings or the availability of Project information.	Newspaper advertisements were placed in: • The Herald in Zimbabwe Published 03/10/2014 in English • The Daily Mail in Zambia Published 02/10/2014 in English
Social Media	• To notify stakeholders of public meetings, applicable dates, venues and times. (Only operational in Zimbabwe.)	Use of Facebook, *WhatsApp* and bulk SMSes
Site notices	• To notify people of the project.	Approximately 20 site notices (A2 and A3 size) were erected in public places
Background Information Document (BID)	• To distribute the Project Background Information Document as widely as possible. • To provide stakeholders with Project information and an indication of the ESIA process to follow.	Printing and distribution of 1,500 BIDs. • 1,000 English BIDs; • 250 Tonga BIDs; and • 250 Shona BIDs.
Face to face meetings and other social engagement tools: • Authorities' meetings • Public meetings • Focus Groups Discussions (FGDs) • Participatory Rural Appraisal (PRA) • Livelihoods Survey • Key Informant Interviews (KII)	• To communicate information about the Project and ESIA process and reinforce two-way communication. • These methods have been employed as part of the socio-economic study of the ESIA.	• 5 x National Government Stakeholders • 4 x Provincial Government Stakeholders • 2 x District Government Stakeholders • 3 x Public Meetings • Multiple face-to-face meetings, FGDs and KII Meetings • 40 x Livelihoods Survey Interviews

Description of Consultation Activities

A total of 1,500 BIDs were distributed (of which 1,000 in English, 250 in Shona and 250 in Tonga). During the Scoping Phase, the meeting Attendance Registers show that 580 people attended the public meetings. This number does not account for engagements through *ad hoc* face-to-face meetings, focus group discussions and people who took BIDs without completing the attendance register. Various size site notices were posted in public places in Zambia and Zimbabwe. The places where site notices were posted are indicated in *Table 5.2* below.

Table 5.2 ***Places where Site Notices were Posted***

Zimbabwe	Zambia
Marineland Harbour	Micho compound
Mahombekombe	Siavonga Fish market
Kariba Heights	Siavonga Market and Bus Rank
Nyamunga	Siavonga District Hospital

A formal Project background and purpose presentation was given at each public and authorities' meeting. Where electricity was not available; posters were used to illustrate Project details.

A summary of all public participation activities undertaken are provided below in *Table 5.3* and *Table 5.4;* copies of the attendance registers are provided in *Annexure A11*; and photographic evidence is provided in *Annexure A12*.

Table 5.3 ***Consultation Activities in Zimbabwe***

Date	Venue	Communication Method	Stakeholder
26-Sep-14	Various venues	Face-to-face meetings. Distribution of BIDs.	Lake Kariba Stakeholders.
26-Sep-14	Lake Kariba Fisheries Research Institute Office	Face-to-face meetings. Distribution of BIDs.	Researchers and Manager.
	Zimbabwe National Parks –Kariba Office	Face-to-face meetings. Distribution of BIDs.	Parks Officials.
29-Sep-14	Various venues	Face-to-face meetings. Focus Group Discussions. Livelihoods Surveys. Distribution of BIDs.	Fishermen. Tourism Operators. CBOs. Traders. Women.
30-Sep-14	Mahombekombe Primary School	Public Meeting. Distribution of BIDs.	General Public.
01-Oct-14	ZTA	Face-to-face meetings. Focus Group Discussions. Livelihoods Surveys. Distribution of BIDs.	Traders. ZTA officials.
	Provincial Government Office	Face-to-face meetings. Distribution of BIDs.	National Parks and Wildlife Authority. Provincial Administrator.
02-Oct-14	Kariba District Office	Authorities' Meetings. Distribution of BIDs.	District Heads of Departments.

Date	Venue	Communication Method	Stakeholder
08-Oct-14	Zimbabwean Commissariat Offices	Interest Group Meetings. Distribution of BIDs.	Zimbabwean Commissariat Directors.
15-Oct-14	National Department of Water and Energy	Authorities' Meetings. Distribution of BIDs.	National Department of Water and Energy.

Table 5.4 Consultation Activities in Zambia

Date	Venue	Meeting method	Stakeholder
24-Sep-14	Various venues	Face-to-face meetings. Focus Group Discussions. Livelihoods Surveys.	Fisheries Department. Fish mongers (women). General Traders.
01-Oct-14	Various venues	Face-to-face meetings. Focus Group Discussions. Livelihoods Surveys.	General Traders. Fishermen.
02-Oct-14	Lake Kariba Inn	Authorities' Meetings. Distribution of BIDs.	District Officials
03-Oct-14	Micho Compound	Face-to-face meetings. Focus Group Discussions. Livelihoods Surveys.	District Health and Education officials. Commercial Fishers (Lake Harvest). Artisanal Fishers.
04-Oct-14	Siavonga Primary School Micho Compound	Public Meetings. Distribution of BIDs.	General Public
06-Oct-14	Provincial Government Offices	Face-to-face meetings. Distribution of BIDs.	Provincial Planners
07-Oct-14	National Department of Water and Energy	Authorities' Meetings. Distribution of BIDs.	National Department of Energy Officials. National Department of Water Officials.

The locations of where site notices were placed and places where public meetings were held are shown in *Figure 5.2 to Figure 5.6* below.

Figure 5.2 Mahombekombe Primary School Meeting (30 September 2014)

Figure 5.3 Siavonga Primary School Meeting (04 October 2014)

Figure 5.4 Micho Compound Meeting (04 October 2014)

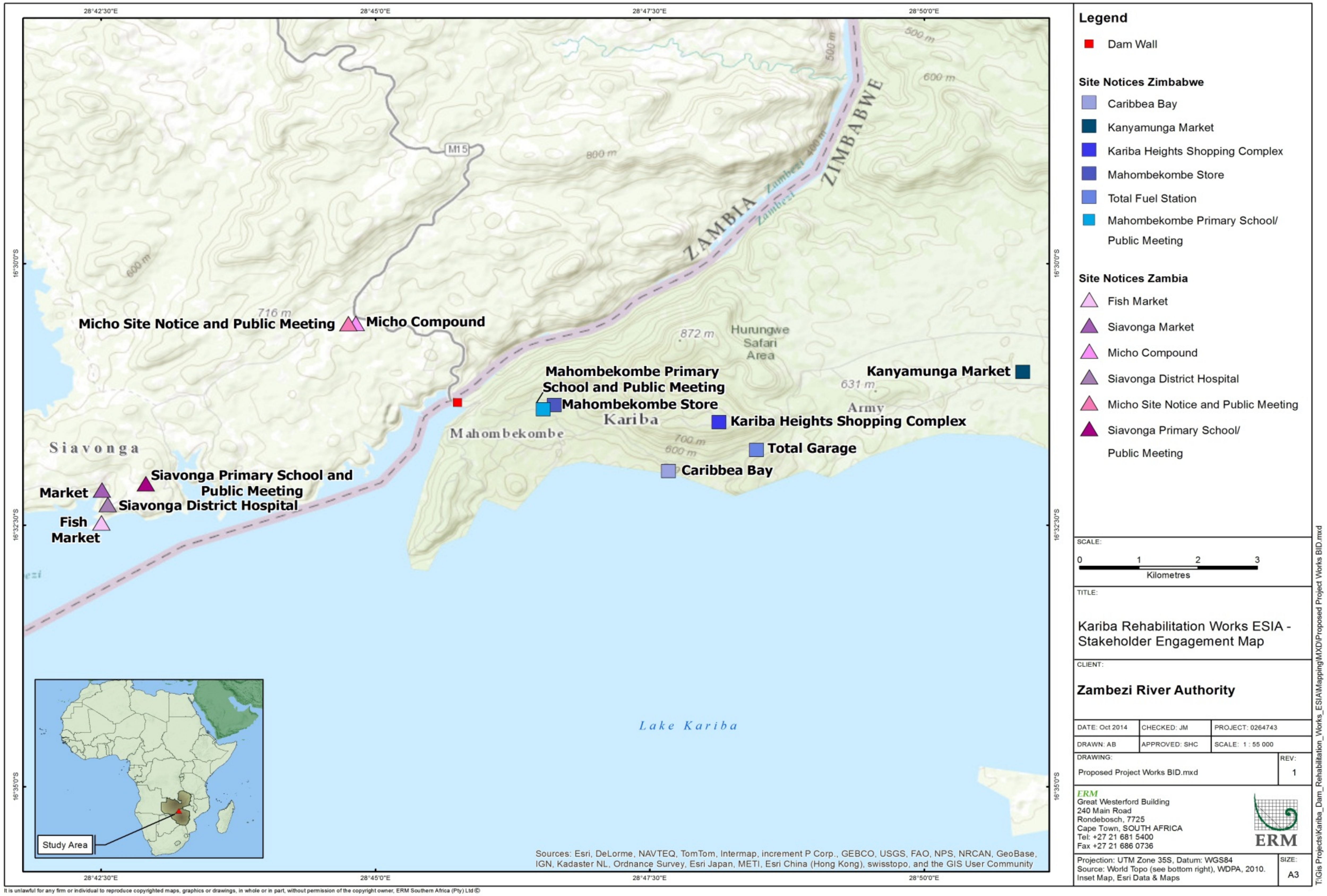
Figure 5.5 *Site Notices*

Site notice at Total Garage-Kariba

Site notice at Micho Compound Market

An overview of issues and concerns raised during the public participation process and engagement during the ESIA phase is presented in *Chapter 7*. Moreover, *Annex C* includes a full list of stakeholders that were consulted throughout the ESIA process.

Figure 5.6 Map Showing the Location of Site Notices and Meeting Venues



5.4 BASELINE DATA COLLECTION

One of the main objectives of the ESIA process was to collect suitable data on the physical, biophysical and social environment, so as to understand what receptors and resources have the potential to be *significantly* affected by the proposed Kariba Dam Rehabilitation Project. *Chapter 8* describes the baseline conditions that have been used to make the assessment of both environmental and social impacts (the impact assessment is presented in *Chapter 9* of this ESIA). The description of the baseline aims at providing sufficient detail to meet the following objectives:

- Identify the key conditions and sensitivities in areas potentially affected by the Project;
- Provide a basis for extrapolation of the current situation, and development of future scenarios without the implementation of the Project;
- Provide data to aid the prediction and evaluation of possible impacts of the Project;
- Understand stakeholder concerns, perceptions and expectations regarding the Project;
- Allow the Project to develop appropriate mitigation measures later in the ESIA process; and
- Provide a benchmark to assess future changes and to assess the effectiveness of mitigation measures.

As part of this ESIA process primary (in-field) baseline data collection studies were undertaken for –

- Hydrology
- Aquatic Ecology
- Terrestrial Ecology
- Social

The primary baseline data collection methodologies associated with these studies are presented below.

5.4.1 *Hydrology*

In order to understand the impacts of the aquatic ecology, an understanding is required of how the hydrological (flow) regime will be changed by the Project. To understand this, a hydrological impact assessment was undertaken and included the following:

- A desktop study to identify any naturalised, or simulated natural inflow streamflow time-series to Kariba Dam.

- Assessed the identified streamflow time-series to determine the monthly and annual Flow Duration Curves (FDCs).

- Using the FDCs as the primary point of comparison, the FDCs for the identified streamflow time-series into the dam were compared against the most representative Hughes Desktop Model regions in South Africa.

- Once a region was selected as the starting point, the regional parameters within the Hughes Desktop Model were adjusted to best suite the monthly flow duration curves identified for the site. This was undertaken for two ecological classes.

- A hydraulic cross-section based on a site-specific survey was generated.

- A workshop between the hydrologist and aquatic ecologists was held (in in order to discuss the newly derived site specific distributions and the results produced.

- The final flows generated were superimposed upon the hydraulic cross-section to provide an indication of flow depth and habitat availability.

- Based on the above information, an impact assessment on the aquatic ecology was undertaken. The hydrologist worked with the aquatic ecologist to propose relevant mitigation and monitoring measures that were included in the ESIA and ESMP.

5.4.2 *Aquatic Ecology*

A detailed assessment of 3 sites (ZR1, ZR2 and ZR3) were strategically selected downstream of Kariba Dam. Information gathered at these sites was used to determine the Present Ecological State (PES) and Ecological Importance and Significance (EIS) of the aquatic environments. Significant biological and physico-chemical impacts were pinpointed and dealt with in an appropriate amount of detail. The Scope of Work for the aquatic ecology study is outlined below:

- A high and a low flow assessment, in line with local and international standards.

- A detailed literature review of information pertaining to the aquatic ecology of the area.

- A baseline characterization of the aquatic environment at ZR1, ZR2 and ZR3 included the application of the following metrics:

Response Metrics:

- Aquatic macroinvertebrates (MIRAI - Dickens & Graham, 2002)
- Fish (FRAI - Kleynhans, 2007);
- Diatom assessment (Taylor *et al*., 2005); and
- In situ water quality measurements [pH, electrical conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Turbidity].

Drivers Metrics:

- Habitat Indicators (IHAS and IHI - McMillan, 1998; Kleynhans, 1999); and
- Water quality measurements (in situ, turbidity, major cat and anions, nutrients and metals).

- Impact Assessment:

  - Undertaken from a hydrological flows perspective based on the proposed reduction during the construction phase of the new stilling basin and associated works.

  - Highlights impacts that may have the potential to alter the ecological functioning and integrity of the downstream surface water system. The magnitude of the impacts is directly relative to the current state of the abiotic factors and the associated sensitivity of the receiving aquatic community to these alterations.

5.4.3 *Terrestrial Ecology*

A detailed assessment of the terrestrial ecological impacts of the Kariba Dam Rehabilitation Works was undertaken by firstly gathering relevant baseline data and secondly assessing the ecological impacts. Thereafter recommendations were made to mitigate impacts and monitoring measures proposed. A baseline assessment of the terrestrial ecology was conducted to assess the sensitivity of the environment. The baseline assessment focused on the following four aspects:

- **Determination of a Direct Area of Influence (AoI)**: a direct Ecological Area of Influence (AoI) was established based on the footprint of the Project.

- **Mapping and Classification of the Broad Habitats within the Direct AoI**: the vegetation of the area was classified and used as the basis for the assessment and mapping of habitats within the direct AoI, covering both the Zambian and Zimbabwean terrestrial environments. These habitats were assessed during a single season of fieldwork to confirm the conformance of the adopted classification system, species determination and diversity within the AoI and the presence of plant species of importance (threatened and rare species). Fieldwork did not only focus on vegetation, but also include faunal observations on mammals, birds and other faunal groups of importance in the area. Observations relied on direct sightings, evidence of presence and consultation where appropriate with people knowledgeable on the ecology of the area.

- **Floral and Faunal Sensitivity Assessment of the AoI, with Emphasis on the Areas that will be Directly Impacted through the Proposed Construction Activities**: The current state of the identified habitats were determined based on levels of transformation, alien species presence, faunal and floral species diversity and species of importance.

- **Define the Broader Sensitivities Downstream of the Dam, based on Available Desktop Data**: An indirect AoI was described covering the areas downstream of the Kariba Dam Wall that are influenced by the flow release schemes implemented by the power generation schemes. The indirect AoI include the riparian zones of a number of prominent protected areas on both side of the Zambezi River.

The above Ecological Baseline guided an assessment of the expected impacts to the terrestrial ecology as a result of the proposed Project. Mitigation measures were developed where possible to avoid, minimise or reduce the significance of the identified impacts. The detailed requirements for implementing these mitigation measures, together with monitoring of their success were incorporated into the ESMP.

5.4.4 *Social*

The social baseline study was compiled from publicly available secondary data. The secondary data was supplemented by primary data that was collected by way of various social data gathering methods.

Due to the limited Project footprint and concomitantly limited expected social impacts, a mini-livelihoods survey was conducted with 40 participants in Mahombekombe and Kariba Heights in Zimbabwe combined with Siavonga Town and Micho in Zambia.

In addition four focus group discussions (FGDs) were also undertaken with representatives of traders, fishermen and two local women's groups (one each in Zimbabwe and Zambia). *Ad hoc* one to one meetings were also held with key informants including health and education officials as well as the district planner in Zambia and the town clerk in Zimbabwe.

Secondary data sources included:

- The most recent Population and Household Census information of both countries;
- Demographic and Health Survey information;

- Research reports from various international NGOs and organisations; and
- Other sources of information identified via the Internet.

Influencing Factors

The baseline study presented in *Chapter 8* is influenced by the following four factors:

1. After assessing the size of the Project footprint and the types of activities that will occur, it was noted that the Project will have limited social impacts; therefore primary data collection was limited to a small sample size.

2. The relatively small sample size means that the results of the study cannot be extrapolated to the wider population of Kariba and Siavona Districts.

3. The tendency of respondents to exaggerate their circumstances means that not all data can be assumed to be purely factual but may also be anecdotal.

4. In certain cases outdated data (information older than five years) has been used due to a lack of current data, as such this data may no longer represent the current reality of the population.

5.5 INTERACTION WITH DESIGN AND DECISION-MAKING PROCESS

The interaction between the ESIA team and the design and decision-making process is one of the key areas in which an ESIA can influence how a project develops. It includes involvement in defining the Project and identifying those activities with the potential to cause environmental and social impacts (e.g. physical presence, downstream aquatic impacts, workforce, traffic, local employment, procurement). Project planning, decision-making and refinement of the Project description continue throughout the assessment process in response to the identified impacts.

During the ESIA process, there was liaison between the proponent (ZRA) and ERM with regard to identifying impacts and potential mitigation measures. An example of this was the development of early design criteria so as to ensure that the high level siting of significant construction activities (*viz.* the dumping of waste rock) avoids undisturbed areas and takes place in areas that are already disturbed.

5.6 ASSESSMENT OF IMPACTS AND MITIGATION

The impact assessment stage comprises a number of steps that collectively assess the manner in which the Project will interact with elements of the physical, biological and social environments to produce impacts to resources/receptors. The steps involved in the impact assessment stage are described in greater detail below.

5.6.1 *Impact Assessment*

The impact characteristic terminology used is summarised in *Table 5.5*.

Table 5.5 ***Impact Characteristic Terminology***

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

In the case of *type*, the designations are defined universally (i.e., the same definitions apply to all resources/receptors and associated impacts). For these universally-defined designations, the definitions are provided in *Table 5.6*.

Table 5.6 ***Designation Definitions***

Designation	Definition
Type	
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
Extent	
Local Regional International	Defined on a resource/receptor-specific basis.
Duration	
Temporary Short-term	Defined on a resource/receptor-specific basis.

Designation	Definition
Long-term	
Permanent	

In the case of *extent* and *duration*, the designations themselves (shown in *Table 5.5*) are universally consistent, but the definitions for these designations will vary on a resource/receptor basis (e.g., the definition of what constitutes a "short term" duration for a noise-related impact may differ from that of a "short term" duration for a habitat-related impact). This concept is discussed further below.

In the case of *scale* and *frequency*, these characteristics are not assigned fixed designations, as they are typically numerical measurements (e.g., number of acres affected, number of times per day, etc.).

The terminology and designations are provided to ensure consistency when these characteristics are described in an impact assessment deliverable. However, it is not a requirement that each of these characteristics be discussed for every impact identified.

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, operational release of toxic gas, community riot, etc.) is *likelihood*. The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale, as described in *Table 5.7*.

Table 5.7 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred.

It is important to note that likelihood is a measure of the degree to which the unplanned event is expected to occur, *not* the degree to which an impact or effect is expected to occur as a result of the unplanned event. The latter concept is referred to as *uncertainty*, and this is typically dealt with in a contextual discussion in the impact assessment deliverable, rather than in the impact significance assignment process.

In the case of impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation. There is an inherent challenge in discussing impacts resulting from (planned) Project activities and those resulting from unplanned events. To avoid the need to fully elaborate on an impact resulting from an unplanned event prior to discussing what could be a very low likelihood of occurrence for the unplanned event, this methodology incorporates likelihood into the magnitude designation (i.e., in parallel with consideration of the other impact characteristics), so that the "likelihood-factored" magnitude can then be considered with the resource/receptor sensitivity/vulnerability/importance in order to assign impact significance. Rather than taking a prescriptive (e.g., matrix) approach to factoring likelihood into the magnitude designation process, it is recommended that this be done based on professional judgment, possibly assisted by quantitative data (e.g., modelling, frequency charts) where available.

Once the impact characteristics are understood, these characteristics are used (in a manner specific to the resource/receptor in question) to assign each impact a *magnitude*. In summary, magnitude is a function of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood.

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor. As in the case of extent and duration, the magnitude designations themselves (i.e., negligible, small, medium, large) are universally used and across resources/receptors, but the definitions for these designations will vary on a resource/receptor basis, as is discussed further below. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

The magnitude of impacts takes into account all the various dimensions of a particular impact in order to make a determination as to where the impact falls on the spectrum (in the case of adverse impacts) from *negligible* to *large*. Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact, and should be characterised as having a *negligible* magnitude. In the case of *positive* impacts no magnitude will be assigned.

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human. Where the resource is physical (for example, a water body) its quality, sensitivity to change and importance (on a local, national and international scale) are considered. Where the resource/receptor is biological or cultural (for example, the marine environment or a coral reef), its importance (for example, its local, regional, national or international importance) and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact.

Impact significance is designated using the matrix shown in *Table 5.8*.

Table 5.8 Impact Significances

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor- or impact-specific considerations are factored into the assignment of magnitude and sensitivity designations that enter into the matrix. *Box 5.3* provides a context for what the various impact significance ratings signify.

Box 5.3 *Context of Impact Significances*

An impact of ***negligible*** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of ***minor*** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of ***moderate*** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of ***major*** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of impact assessment is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

5.6.2 *Mitigation of Impacts*

Once the significance of a given impact has been characterised using the above mentioned methodologies, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

It is important to have a solid basis for recommending mitigation measures. The role of any given ESIA is to develop a consentable project, and to help develop the project in a responsible manner. Impact assessment is about identifying the aspects of a project that need to be managed, and demonstrating how these have been appropriately dealt with. As key influencers in the decision making process, the role of the impact assessment is not to stop development or propose every possible mitigation or compensatory measure imaginable, but rather to make balanced judgements as to what is warranted, informed by a high quality evidence base.

Additional mitigation measures should not be declared for impacts rated as not significant, unless the associated activity is related to conformance with an 'end of pipe' applicable requirement. Further, it is important to note that it is not an absolute necessity that all impacts be mitigated to a not significant level; rather the objective is to mitigate impacts to an *as low as reasonably possible* (ALARP) level.

Embedded controls (i.e., physical or procedural controls that are planned as part of the project design and are not added in response to an impact significance assignment), are considered as part of the project (prior to entering the impact assessment stage of the impact assessment process).

5.6.3 Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

5.6.4 Dealing with Uncertainty

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty, but in projects such as the proposed Kariba Dam Rehabilitation Project where the design process is currently in progress, uncertainty stemming from on-going development of the Project design is inevitable, and the environment is typically variable from season to season and year to year. Where such uncertainties are material to ESIA findings, they will be clearly stated and conservatively approached ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation.

5.6.5 Cumulative Impacts/Effects

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects.

The impact assessment process will predict cumulative impacts/effects to which the Project may contribute. The approach for assessing cumulative impacts and effects resulting from the Project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the 'other' activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

A cumulative impact assessment for the Project is detailed toward the end of *Chapter 9* of this ESIA report.

5.6.6 *Management Systems*

Stakeholders and external decision-makers for the Project will rely on the findings of the ESIA (e.g. the significance of residual impacts) in coming to their ultimate views. As an ESIA is based on predictions made in advance of an activity taking place, it effectively makes assumptions that the project will implement certain controls and mitigation measures. If the controls do not happen, then the ESIA is undermined as a tool for stakeholders and external decision-makers. It is important, therefore, that these 'assumptions', i.e. the mitigation / management measure recommendations detailed in *Chapter 9*, are commitments that will be implemented through the environmental and social management plan (ESMP – refer to *Part III* of this ESIA) that has been developed together with the proponent and as part of the ESIA process.

It is also important that, over the life of the Project, the vehicle by which the commitments set out in the aforementioned ESMP are turned into specific actions and implemented through an Environmental and Social Management System. This system has been initiated through the development of the ESMP and will continue to be developed as the Project proceeds. The implementation of such a system should ensure that any unforeseen impact or issues that may arise will be dealt with in an effective manner in accordance with international and national requirements. In this way, stakeholders and external decision-makers should have confidence in the ESIA as a tool to aid their decision-making on the Project.

Once potential impacts have been identified and mitigation measures developed and described in the ESIA, their *integration* within the Project is required in order to ensure their future implementation. In order for this to be successful, a statement of the responsibility, timing and reporting requirements associated with each measure or set of measures is generally issued. It is also required as part of the Environmental and Social Management System to develop procedures by which these measures will be monitored and to include mechanisms that allow for their on-going development in order to minimise impacts to ALARP levels, or to achieve continuous improvement throughout the Project's duration.

5.6.7 *Reporting and Disclosure*

This ESIA report together with the ESMP will be disclosed to registered stakeholders for a four week duration.

5.6.8 *Uncertainty and Change Management*

As Project design is finalised, design changes may occur that need to be accommodated by the ZRA and its associated contractors. Similarly, the organisational structure and roles and responsibilities included in the ESMP (*Part III* of this ESIA) may also change as the Project progresses.

The ESIA process does not stop with submission of the ESIA report to the authorities. Therefore, the ESMP will require a mechanism to manage change. At times these changes may be material, potentially influencing the original findings of the ESIA, and hence, the basis for its approval. Such a mechanism to manage change, or a change management system, must ensure that changes to the scope of the Project are subjected to a robust social and environmental assessment process. Any changes to Project scope will be evaluated for their degree of significance, and will be incorporated into the appropriate ZRA documentation as follows:

- Minor changes will be reflected in updates to the ESMP; and
- Substantive design / technology changes that might potentially alter the ESIA findings (i.e. those that result in changes to the predicted significance of environmental and social impacts) will be subject to re-assessment, further stakeholder consultation, supplementary reporting and revision of the ESMP. Typically, such substantive changes will be submitted to the ZEMA and EMA as an addendum to this ESIA, and will need to go through an approval process in accordance with Section 105 of the Zimbabwean Environmental Management Act, (Chapter 20:27) and the Zambian Environmental Impact Assessment Regulations No 28 of 1997.

6 PROJECT ALTERNATIVES

The key alternatives considered for the Kariba Dam Rehabilitation works are discussed in this *Chapter*.

6.1 WASTE ROCK DUMP SITE ALTERNATIVES

6.1.1 *Alternative 1: Old Disused Sinohydro Quarry Site*

The Sinohydro quarry site is located at GPS co-ordinates 16^{0}30'20.58"S 28^{0}45'45.34"E (depicted as "Sinohydro open quarry pit" in *Figure 6.1*). This area is the old quarry site used during the construction of the Kariba North Power Station, during the 1970s. The site has the following benefits:

- The volume of the quarry is large enough to accommodate almost all the excavation material;
- There will be no significant visual impact associated with the dumped waste rock; and
- There will be no impact on vegetation.

6.1.2 *Alternative 2: Site on Northern River Bank*

One of the areas potentially suitable for deposition of waste rock produced by the plunge pool excavation is the area that runs perpendicular to the Zambezi River at about 1 km downstream of the Kariba Dam wall on the northern (Zambian) bank (depicted as "Area 1" in *Figure 6.1*). From observations carried out from the southern (Zimbabwean) bank, this valley has been disturbed through previous works associated with the Sinohydro Contractor for their activities related to the Kariba North Bank Extension Project. Large volumes of mucking/waste rock are already stocked at the toe of the slope forming a platform. Moreover, a batching plant is also in operation on this alternative site. It is believed that this area is not particularly suitable as it is already largely occupied.

6.1.3 *Alternative 3: Old ZRA Quarry Site*

The old ZRA quarry is accessible through an asphalted road leading to the Caribbea Bay Resort in Zimbabwe (depicted as "Area 3" in *Figure 6.1*). On the left hand side of the road, a rough track of about 200 m in length leads to the old quarry site. It has been established that the old ZRA quarry is too small to receive the volume of waste rock. Further to this, the quarry is located approximately 5 km from the Project site.

6.1.4 Alternative 4: Area East of the Sinohydro Quarry Site

This site alternative (as discussed in *Chapter 4* and illustrated as "Area 2" in *Figure 6.1*) is accessible by an unpaved road and the estimated distance from the plunge pool is about 2.5 km. The site is located immediately east of the existing disused Sinohydro quarry at GPS co-ordinates 16°30'20.30"S 28°45'51.11"E, at elevation 593 masl in an area of typical escarpment woodland. The area is forested and rather flat over some hundreds of meters towards the east and is currently owned by the Zambian Government. Although closer to the plunge pool than Alternative 3, this site is less preferred as there would be potential visual impacts associated with the dumping of waste rock, as well as impacts on the vegetation at the site.

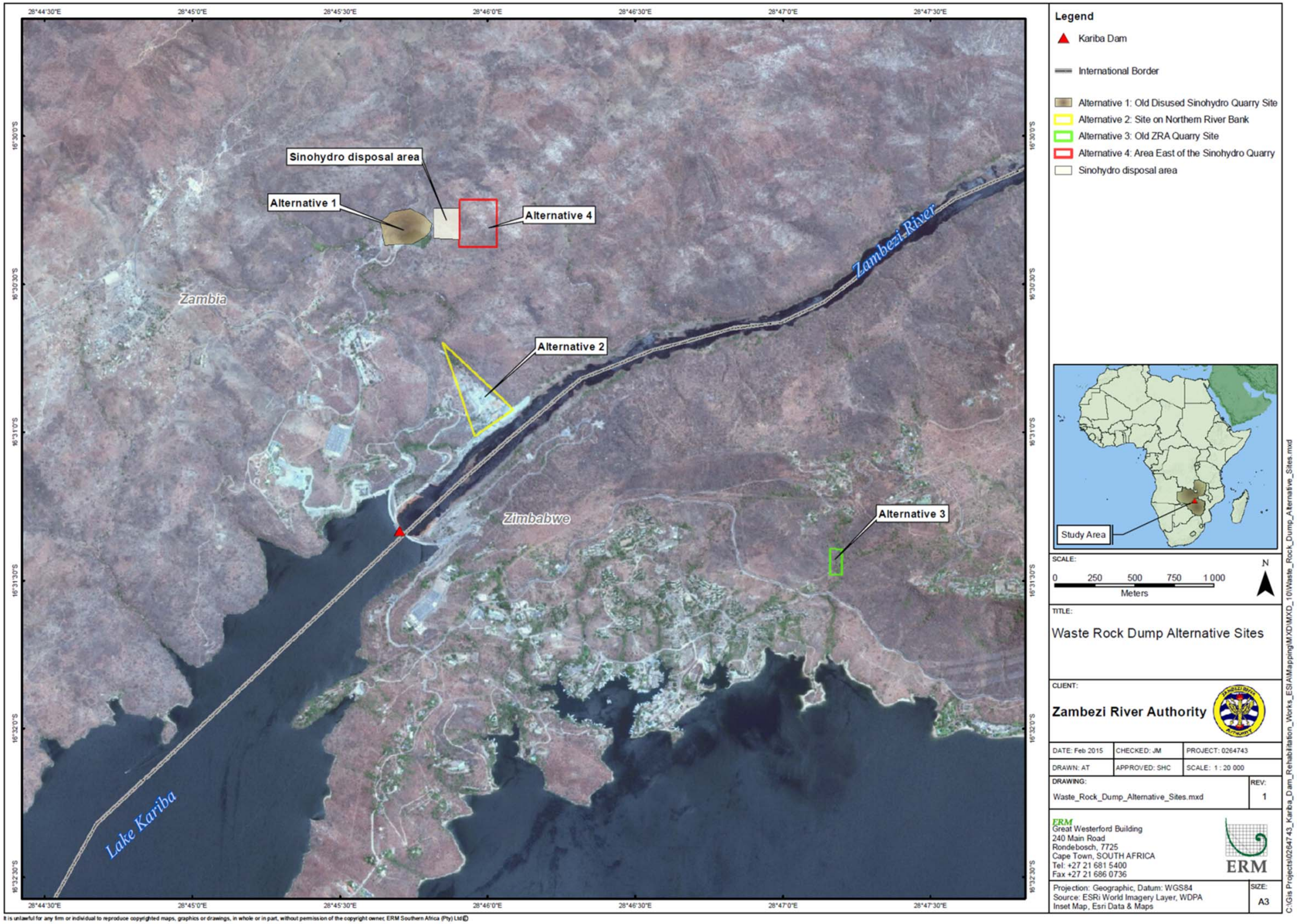
6.1.5 Conclusion

Accordingly the preferred order of the alternatives assessed is, from most preferred to least preferred, as follows:

- Alternative 1: Old Disused Sinohydro Quarry Site
- Alternative 3: Old ZRA Quarry Site
- Alternative 4: Area East of the Sinohydro Quarry Site
- Alternative 2: Site on Northern River Bank

Alternative 1 is the preferred alternative as the Sinohydro quarry is the most suitable site for dumped waste rock (it will have the least visual and terrestrial ecology impacts). Moreover, the site is in close proximity to the plunge pool.

Figure 6.1 Waste Rock Dump Alternative Sites



Source: ZRA, 2014.

6.2 *SLIPWAY SITE ALTERNATIVES*

As described in *Chapter 2*, the slipway will allow assembly of the floating cofferdam on the reservoir bank above water level and launching of the floating cofferdam onto the reservoir.

During feasibility studies, the possibility was examined to use a dry-dock instead of a slipway. However, due to the reservoir level fluctuation range, this solution was found not feasible.

Two engineering site visits were undertaken in December 2011 and April 2012, resulting in the identification of three possible sites for the construction of a slipway. The key characteristics associated with these slipway sites are presented in *Table 6.1*.

Table 6.1 Characteristics of Identified Alternative Slipway Sites

Site	Location	ZRA Property	Geology	Boat Distance to Spillway
Alternative 1: DDF (**preferred site**)	16^{0} 31′ 52.98″ S 28^{0} 45′ 33.41″ E	No	Sandy/gravel	~2.0km
Alternative 2: Wild Site	16^{0} 31′ 51.51″ S 28^{0} 45′ 28.49″ E	No	Rock outcrop + sandy/gravel	~1.2km
Alternative 3: ZPC Sports and Social Club	16^{0} 32′ 5.58″ S 28^{0} 46′ 6.95″ E	No	Sandy/gravel	~6.8km

Source: Tractebel Engineering France / Coyne et Bellier, 2014

The preferred slipway site (Alternative 1: DDF Site) is located about 2.0 km south west from the Kariba Dam wall, and is currently owned and operated by the Zimbabwean District Development Fund (DDF). This site has been selected as the preferred site for the following reasons:

- The site has an existing slipway which can be upgraded;
- The site is flat and large enough to cater for the construction of the floating cofferdam;
- There is an existing road to the site; and
- The site is a short boat distance (2.0km) to the spillway.

Accordingly, the preferred order of the alternatives assessed is as follows:

- Alternative 1: DDF – **most preferred**
- Alternative 2: Wild Site – **next most preferred** (based on its proximity to the spillway [~1.2km])
- Alternative 3: ZPC Sports and Social Club – **least preferred** (based on the fact that the slipway site would be situated ~6.8km from the spillway)

6.3 PLUNGE POOL COFFERDAM ALTERNATIVES

As discussed in *Chapter 2,* three alternative cofferdam designs were considered. These three alternatives are discussed in further detail below.

6.3.1 *Alternative 1*

A cofferdam built from one bank to the other, i.e., continuous, built at the start of the works and demolished at the end. However, removal at the end of the works is costly and time-consuming.

6.3.2 *Alternative 2*

Installing a sheet pile cellular cofferdam at the beginning of the works and removed at the end of each dry season. This is however not a possible option as the removal and reconstruction time is too long before and after each spillage episode.

6.3.3 *Alternative 3*

The preferred alternative would consist of the establishment of a cofferdam at the beginning of the works, removed at the end of the dry season and then re-installed at the beginning of the following dry season. This cofferdam design allows for easier mobilization and demobilization between potential flood events, and allows for a three phase work program. The cofferdam will comprise of 10 piers spaced 13 m apart, with nine stoplogs in between.

6.3.4 *Conclusion*

Alternative 3 is the preferred alternative as the cofferdam can be quickly mobilised and de-mobilised once constructed. A comparison of construction and mobilisation/demobilisation durations for each alternative is presented in *Table 6.2*.

Table 6.2 Cofferdam Alternatives Schedule

(in months)	**Construction (Previous year)**	**Mobilised**	**De-mobilised**
Alternative 1	0	5.5	1.5
Alternative 2	4	2	2
Alternative 3	4	1	0.5 - 1

Source: Tractebel Engineering France /Coyne et Bellier, 2014

Accordingly, the preferred order of the alternatives assessed is as follows:

- Alternative 3 – **most preferred**
- Alternative 1 – **next most preferred**
- Alternative 2 – **least preferred** (as it not a viable option).

6.4 RESERVOIR MANAGEMENT ALTERNATIVES

As the rehabilitation works associated with the plunge pool are located right under the spillway gates, the reshaping works can only be done during a period that will not require spillage, i.e. a "non-spillage period". Normal spillage usually occurs from January to the end of August, leaving a reduced time window for works (i.e. September through to December). The non-spillage period can be increased by lowering the reservoir level and creating a storage volume that will be used as a buffer volume against a flood. This volume allows storing of the flood inflows while the reservoir level is rising.

Simulations were undertaken by Tractebel (2012) to find an optimised scenario that increases the non-spillage period, and limits consequences on energy production and water availability during and after works. Simulations were carried out with two purposes of:

- Protecting the active working area against flood during the whole period of works.

- Lowering the risk of decreased lake levels during drier years and the subsequent impact on electricity production.

Three alternative scenarios, based on a series of assumptions, have been retained depending of the duration made available for works:

- **Alternative Scenario 1**: Allows 16 months for works, and the cofferdam and the excavation works can be done in the same non-spillage period.

- **Alternative Scenario 2**: Allows 11 months for works, and the cofferdam can be partly constructed in advance, and completed just before the excavation works.

- **Alternative Scenario 3**: Allows 7 months for works, and the cofferdam will be rapidly mobilized and demobilized to leave enough time for excavation works.

6.4.1 *Conclusion*

Alternative Scenario 1 allows completion of works in the shortest time, whilst Alternative Scenario 3 limits the loss of water due to less reservoir level lowering, and Alternative Scenario 2 is an intermediate case between the two previous scenario alternatives.

As is indicated above, the preferred alternative is Alternative Scenario 3, where the works can be carried out in the plunge pool for 7 months, after which time all materials and equipment will have to be dismantled to allow for the 5 months spillage period, before the works can be resumed for another 7 months.

The ZRA is able to forecast the start of the wet season by only a month in advance, and the start of the dry season by five months. As such, it is not possible to predict the inflows that will come into the Kariba reservoir during the whole period of works and to adapt the lake level accordingly. Accordingly, it is necessary to choose a protection level on an a priori criterion, without knowing the hydrological situation. The usual criterion for works protection is the 50 years return period flood; it is therefore recommended to follow this criterion. *Table 6.3* shows the results of the modelled outcomes of the three considered scenarios.

Table 6.3 Results of Reservoir Management Scenario Models

	Alternative Scenario 1	Alternative Scenario 2	Alternative Scenario 3 (preferred)
Period available for works (months)	16	11	7
Maximum possible loss of turbined water during a dry year (km3)	22.2	0	0
Maximum reservoir level drawdown at the end of the simulation compared to normal operation (m)	5.20 (min op level)	5.20 (min op level)	1.90
Maximum reservoir Level end of April the first year to be protected against a 50 years return period flood	477	481	484.15

Source: Tractebel Engineering France /Coyne et Bellier, 2014

The results indicate that Alternative Scenario 1 would result in a significant loss of power generation during rehabilitation works (22.2 km^3 of water would not run through the turbines). Alternative Scenario 3 (preferred alternative) would require the lowest maximum reservoir level drawdown (1.9m), which is beneficial to the hydropower facility for future power generation.

Accordingly, the preferred order of the alternatives assessed is as follows:

- Alternative Scenario 3 – **most preferred**
- Alternative Scenario 2 – **next most preferred**
- Alternative Scenario 1 – **least preferred**

6.5 *ALTERNATIVES BLASTING TECHNOLOGIES CONSIDERED* (1)

Rehabilitation of the Plunge Pool involve a significant volume of rock to be excavated, an estimated 300,000 m^3. Such works are similar to those performed in an extraction quarry, and are at the scale of large dam excavation works in rocky banks; however, unusual in the sense that the excavation depth is below the current Tail Water Level and by the proximity of several critical structures such as the dam wall, the power stations' outlets and the unstable South Bank.

(1) Tractebel (2012). *Plunge Pool Reshaping Detailed Design Report*

A critical aspect that needed to be considered as part of the Project design is the explosive material to be used. Generally, for rock extraction inside large open pits, bulk explosive ANFO (ammo-nitrate fuel oil) is used because it is a cost effective option and has sufficient blasting strength. Nevertheless, the water sensitivity of ANFO is very high, which ultimately means that the risk of frequent misfires, as a result of predictable water seepages are during works, is large. As a result, a more effective solution in using modern adequate explosives materials (such as surface bulk emulsions) was deemed as the preferred blasting technique. These explosives have a good water resistance and have a velocity of detonation (strength) better than that of ANFO.

It is observed that these modern explosives are presently commonly used for very large excavation works, for example the third set of lock project of the Panama Canal. Moreover, these surface bulk emulsions are locally available; therefore, there is no foreseen problem of procurement.

The type of explosives used for smooth blasting is different than the one used for pre-splitting and production blasting. In this case, cartridges of explosives are set adjacent at the foot of the bench and with a higher spacing on the upper part of the bench along a detonator wire that is loaded in the hole.

Accordingly, the preferred order of the alternatives assessed for blasting is as follows:

- Modern adequate explosives materials (such as surface bulk emulsions) – **most preferred**.
- Bulk explosive ANFO (ammo-nitrate fuel oil) – **least preferred**.

6.6 SUMMARY OF PREFERRED ALTERNATIVES

Table 6.4 below summarises the preferred alternatives considered in this *Chapter*.

Table 6.4 *Summary of Preferred Alternatives*

Alternative Considered	Preferred Alternative
Waste Rock Dump	**Old Disused Sinohydro Quarry Site** - the most suitable site for dumped waste rock (it will have the least visual and terrestrial ecology impacts). Moreover, the site is in close proximity to the plunge pool.
Slipway	**The Existing DDF Slipway** – the site has an existing slipway, large enough to cater for the construction of the floating cofferdam, there is an existing road to the site and the site is a short boat distance to the spillway (2.0km).

Alternative Considered	Preferred Alternative
Plunge Pool Cofferdam	Established at the beginning of the works, removed at the end of the dry season and reinstalled at the beginning of the following dry season.
Reservoir Management	**Allows 7 months for works** - limits the loss of water due to less reservoir level lowering.
Blasting Technologies	**Surface bulk emulsions** – as they are locally common, proven to work and have a high velocity of detonation.

6.7 NO-GO ALTERNATIVE

PLEASE NOTE:

The No-Go alternative is the option of not undertaking the Kariba Rehabilitation Works Project.

As described, water is released from the reservoir through six sluice gates. In the first 20 years after the dam was constructed there were sustained heavy spillage episodes resulting in erosion of the bedrock to 80 m below the normal water level. This area is known as the 'Plunge Pool'. The plunge pool represents a risk to the stability of the dam wall and therefore risk of a flood event and reduced operating capacity of the dam.

Furthermore, there is also a need to rehabilitate the six sluice gates that make up the spillway. The work needed within the sluices is associated with the refurbishment of the concrete surface of all sluices which have been distorted over the years due to an advanced alkali-silica reaction. Without functional sluices the reservoir level cannot effectively be maintained to take into account the flood regime of the Zambezi River. Without the ability to release water from the reservoir, there is a danger of the reservoir being too full prior to a flood event, and the subsequent flood event causing over topping of the dam wall which could lead to dam failure.

Failure to implement remedial measures to the plunge pool and spillway will result in the failure to operate the reservoir as expected (i.e. at a reduced capacity) and an increase in the risk of dam wall failure. A scenario where the dam wall fails will release a flood event of a total 273 km^3 resulting in a major loss of life as the flood plain is home to approximately three million people; loss of livelihoods (socio-economic activities); environmental degradation; and a loss of main source of power to the region. Therefore, the No-Go alternative is not a reasonable alternative and it is necessary to implement the remedial action to avoid such an event.

7 PUBLIC PARTICIPATION PROCESS

This *Chapter* describes the Public Participation Process for during the ESIA phase. It presents the key issues and concerns raised during the consultation. Supporting documentation (proofs) is provided within *Annex C* (Consultation Materials) under the following headings:

- *Annexure C1 – C3*: Background Information Documents (BIDs);
- *Annexure C4 – C5*: Site Notices
- *Annexure C6*: Proof of Site Notice
- *Annexure C7 – C8:* Proof of Advertisements
- *Annexure C9*: Project Presentation
- *Annexure C10*: Issues and Concerns Log
- *Annexure C11:* Attendance Registers
- *Annexure C12*: Photolog
- *Annexure C13*: Stakeholder Database
- *Annexure C 14*: Record of Environmental and Social Impact Assessment - Engagements
- *Annexure C 15*: Non-technical Summaries (English, Shona, and Tonga)
- *Annexure C 16*: Meeting Attendance Registers
- *Annexure C 17*: Pictures taken at Meetings
- *Annexure C 18*: Updated Issues Log
- *Annexure C 19*: Comment Sheets
- *Annexure C 20*: Notification of Additional Stakeholders

7.1 PUBLIC PARTICIPATION PROCESS

The public participation process was designed to comply with Zimbabwean and Zambian regulations and requirements; as well as with international requirements such as the International Finance Corporation (IFC), the World Bank and African Development Bank (AfDB) requirements.

7.1.1 Objectives of the Public Participation Process

The objectives of engaging with stakeholders during the ESIA process include:

- **Ensure Understanding**: an open, inclusive and transparent process of culturally appropriate engagement and communication will be undertaken to ensure that stakeholders are well informed about the Project. Information will be disclosed as early and as comprehensively as possible.

- **Involving Stakeholders in the Assessment**: Stakeholders will be included in the scoping of issues, the assessment of impacts, the generation of mitigation and management measures and the finalisation of the ESIA report. They will also play an important role in providing local knowledge and information for the baseline to inform the impact assessment.

- **Building Relationships**: Through supporting open dialogue, engagement will help establish and maintain a productive relationship between the ESIA team and stakeholders. This will support not only an effective ESIA, but will also strengthen the existing relationship between the ZRA and stakeholders.

- **Engaging Vulnerable Peoples**: An open and inclusive approach to consultation increases the opportunity of stakeholders to provide comment and voice their concerns on the Project. Some stakeholders need special attention because they are vulnerable, therefore special measures will be considered to ensure that the perspectives of vulnerable stakeholders are heard and considered.

- **Managing Expectations**: It is important to ensure that the Project does not create or allow unrealistic expectations to develop amongst stakeholders with respect to Project benefits. The public participation process will serve as a mechanism for understanding and managing stakeholder and community expectations, where the latter will be achieved by disseminating accurate information in an accessible way.

- **Ensuring Compliance**: The public participation process is designed to ensure compliance with country specific regulatory requirements and international good practice.

One of the key outcomes of engagement should be free, prior and informed consultation with stakeholders, where this is understood to mean:

- **Free**: Engagement free of external manipulation or coercion and intimidation;

- **Prior**: Engagement undertaken in a timely way, namely during the planning and design phase of the project and not during the implementation phase; and

- **Informed**: Engagement enabled by stakeholders receiving relevant, accurate, understandable and accessible project information (1).

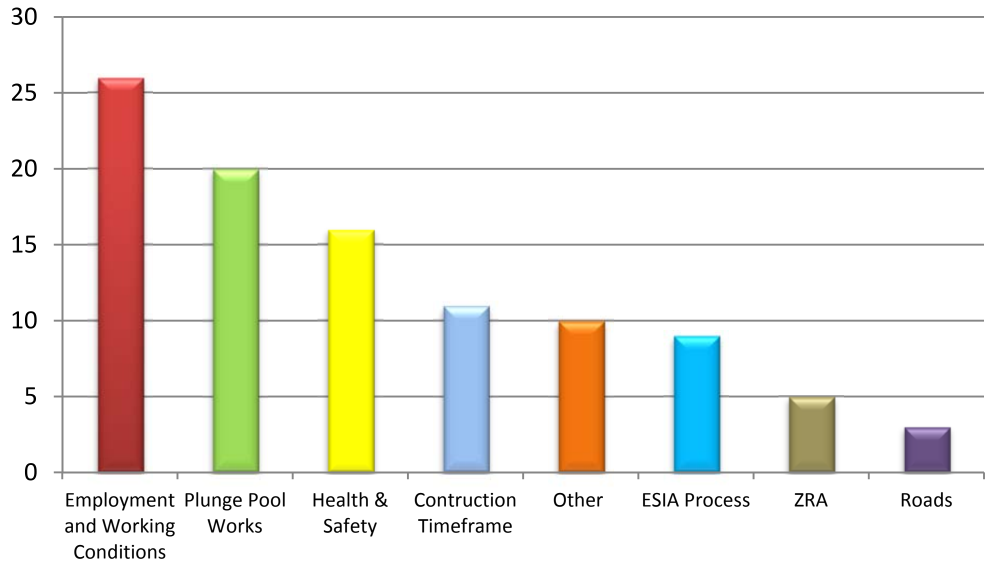
7.2 *ISSUES AND CONCERNS RAISED*

The issues and concerns raised by stakeholders were captured in the Issues Log (*Annexure C10*). The Issues Log is used to inform the social baseline study, as well as the impact identification and assessment process. An analysis of the Issues Log (*Annexure C10*) indicates that issues and concerns

(1) IFC, 2007, Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets

related to employment opportunities and working conditions dominated the consultation process (25 percent). This was followed by concerns related to the plunge pool rehabilitation works at 20 percent. Health and safety concerns linked to the alleged potential collapse of the Kariba Dam wall and enquiries linked to the availability of the emergency response procedures for the downstream users follows with 16 percent of the captured issues. Further details on the issues and concerns raised are provided in the *Figure 7.1* below.

Figure 7.1 Raised Issues and Concerns per Broad Category in Percentages



Stakeholder issues and concerns are further analysed in *Table 7.1* below.

Table 7.1 Summary Analysis of Stakeholder Issues and Concerns

Main Category	Sub-Category	Description
Employment and Working Conditions	Employment opportunities	• There should be equal distribution of employment opportunities between the two affected countries. • Indicate the number and type of employment opportunities to be created as part of the works, both temporary and permanent. • Ensure employment of local people by contractors rather than employees from outside the immediate project area. • Male and female job applicants should be considered equally and women should not be discriminated against based on their sex. • Request to provide advanced/early readiness training to allow local employees to secure skilled positions in addition to unskilled positions.
	Employment procedures	• Request that recruitment should be done through traditional leaders. • Request that recruitment should not be done through traditional leaders due to nepotism; ZRA's "raffle**" employment method is unjust. • The workforce representatives will need to be elected to represent the interests of the workforce and to ensure that the contractors do not abuse the local workforce. • The nature of the proposed project works is dangerous. Therefore the ZRA will need to make sure that all employers have workforce compensation and insurance in place in case of an injury. ***** A raffle is a competition in which people obtain numbered tickets, each ticket having the chance of getting a casual job.***
	Contractors and working conditions	• Concerns raised over the treatment of workers by Chinese contactors particularly.
	Contractors and wages	• Concerns raised over differences in remuneration for similar work between workers employed by ZRA and workers employed by ZRA's contractors.

Main Category	Sub-Category	Description
Refurbishment of Plunge Pools	Plunge pool construction works	• Request to understand plunge pool design alternatives. • Request behind the logic of commencing with plunge pool refurbishment rather than spillway refurbishment. • Effectiveness of the plunge pool monitoring activities currently used. • Query on how and if plunge pool refurbishment will impact on power generation. • Query on what anticipated impacts of dam spilling during the construction of the plunge pool would be. • Queries on what the likely impacts of draining the water out of the plunge pool would be. • The plunge pool has been there for more than 50 years If ZRA drains plunge pool it might have adverse effects on the surrounding area. Has detailed research been done on the effects of the drainage of the plunge pool? • Recommendation was made that the design engineers need to consider the following issues; the drainage of the plunge pool will create instability in the surrounding area, due to over time, water from the plunge pool has seeped into the cracks of the riverbed rock and has created a "cushion". When water is drained, the vacancies between the rocks might cause the collapse of the bedrock. • It is believed that the water in the plunge pool stabilises the dam and therefor people are concerned about the stability of the dam during construction. • It was recommended that ZRA must appoint engineers and a workforce that has experience working in wet conditions such as Konkola Mine in Zambia. • What impacts is the construction of the cofferdam likely to have further downstream.
	Excavated rock dump	• Anticipated impacts of dumping excavated rock from the plunge pool at identified quarry site. • Possible donation of waste rock to local government for use on small project.
Health and Safety	Safety of Embankment / Dam	• ZRA should open up the sluice gates to release the pressure off the dam/embankment. • Queried whether the proposed construction activities will not weaken the dam further? • Will there be a disaster (such as dam collapse) if water is not released from the dam soon? • Is it true the dam will collapse as is reported in the media? • Will the blasting required to refurbish the plunge pool, affect the integrity of the embankment/dam?
	Cracking of the embankment /dam	• Is it true that the embankment/dam is cracked?

Main Category	Sub-Category	Description
	Emergency response procedures	• What emergency measures are in place to ensure the safety of downstream residents in case of a disastrous event? • Request for ZRA to install early warning systems downstream in case of an emergency. • Is there an emergency response plan in place in case the dam collapses?
	Movement of southern slope	• Care should be taken when blasting in the plunge pool area as the southern slope is moving towards the river.
Construction Timeframe	Construction timeframe	• Expected duration of construction activities for the plunge pool and the sluice gates. • Expected start date of construction. • What will happen to the workforce during the months when no construction will take place? • Will the workforce receive payment during the months with no construction activities?
General	General issues	• Consultation with the local population should be handled with great sensitivity due to the historical issues linked to the historical resettlement issues from the 1950s. • Will the proposed project include the construction of a new bridge or dam/embankment? • Reminder that all levels of government and local, regional and national should be provided with project information. • Query whether there are other dams globally that have the same technical challenges as Kariba?
ESIA Process	Process issues	• Request for stakeholder feedback sessions to be held after conducting the scoping meetings. • Planned completion date of the ESIA. • Queries on what the purpose of the scoping meetings is. • Requested clarity on the extent of the geographical area in which project consultations will take place.
	Specialist Studies	• Questioned the expected impacts on fish resources upstream of the embankment due to the construction activities. • Requested that the Aquatic Ecology report should be made available when complete.
ZRA	Provision of Water	• Stated that ZRA made a historical undertaking to provide the population around the Kariba Dam with water. This has not happened.

Main Category	Sub-Category	Description
	Inaccessibility of ZRA to Stakeholders	• ZRA does not have an office in Siavonga, only in Lusaka and Kariba. Thus to be able to apply for employment, people have to incur expenses to cross the border. ZRA should consider providing an employment application facility on both sides of the river. • It is alleged that ZRA is not very successful in communicating project information to the local communities.
	Inadequate Feedback	• Alleged that ZRA is not sharing project information with local people and that they have to get access to project information via the media.
Roads	Construction of access roads	• Will any access roads be constructed and or rehabilitated on the Zimbabwean side of the site? • Will the road between Makuti and Kariba be used to transport construction material and plant? The road is already not coping with its current traffic load.

7.3 *ESIA ENGAGEMENT*

The ESIA stakeholder engagement process was undertaking during the week starting the 2nd March 2015. The objective of this phase of engagement was to:

- Present the key social and environmental impacts identified in the ESIA report, and proposed mitigation;
- Involve stakeholders in assessing the efficacy and appropriateness of the proposed mitigation measures;
- Capture stakeholder concerns and opinions on the identified impacts; and
- Identify revisions or additions to the ESIA report where necessary.

7.3.1 *Description of Consultation Activities*

The ESIA engagement process targeted the following stakeholders:

- National, Provincial, and District level government officials;
- Local Communities (within sub-basin 5); and
- Other Interest groups/ or parities.

Table 7.2 below provides the ESIA engagement schedule.

Table 7.2 Draft ESIA Disclosure Schedule

Day	Date	Activity
		ZAMBIA
Tuesday	03-Mar	Meeting with National Government Stakeholders
Wednesday	04-Mar	Meeting: Southern Provincial Govt. Stakeholders
Thursday	05-Mar	Meeting: Siavonga District Officials
Friday	06-Mar	Meeting: Micho Community
Saturday	07-Mar	Meeting: Siavonga Town Community
Sunday	08-Mar	Meeting: Downstream Users (TBC)
		ZIMBABWE
Tuesday	03-Mar	Meeting: National Government Stakeholders
Wednesday	04-Mar	Meeting: M. West Provincial Government Stakeholders
Thursday	05-Mar	Meeting: Kariba Dam Steering Committee
Friday	06-Mar	Meeting: Mahombekombe Community
Saturday	07-Mar	Meeting: Kariba Heights Community
Sunday	08-Mar	Meeting: Downstream Users (TBC)

In addition to the above, ERM consulted with five Chiefs in Zimbabwe, whom the EMA believed needed to be included as stakeholders in the ESIA and associated Public Participation Process. These Chiefs included His Royal Highness –

- Chief Mola;
- Chief Negande;
- Chief Musambakuruma;

- Chief Nebiri; and
- Chief Nyamhunga.

In this respect, ERM contacted the Assistant District Authority (ADA) in Kariba District to assist with the distribution of a copy of the Non-technical Summary (NTS) and personalised letter to the above mentioned Chiefs. The NTS' and personalised letters were couriered to the ADA office on the 21st April 2015, which was acknowledged as being received on the 20 May 2015.

The personalised letters detailed the proposed Project and associated ESIA process being undertaken. Moreover, the letters presented and explained the purpose and layout of the NTS and provided the contact details for where comments regarding the ESIA process or Project proposed could be directed to. The ADA then distributed the NTS' and associated letters at the General District Authorities meeting in May 2015. The personalised letters sent to the Chiefs can be access in *Annex C* of *Part II* of this ESIA.

In addition to the above, EMA requested that ERM consult with the following National Government Ministries in Zimbabwe:

- Ministry of Finance and Economic Development;
- Ministry of Home Affairs;
- Ministry of Transport and Infrastructural Development;
- Ministry of Mines and Mining Development;
- Ministry of Tourism and Hospitality Industry;
- Traffic Safety Council of Zimbabwe;
- UNESCO; and
- Zimbabwe Tourism Authority.

These Ministries were notified of the proposed Project and associated ESIA process being undertaken via email and fax communication on 09 April 2015. As with the Chiefs, Ministries received a copy of the NTS and personalised letters explaining the Project and process being undertaken. Proof of engagement in this respect is included in *Annex C* of *Part II* of this ESIA.

The ESIA engagement process included:

- Public meetings (for the local communities, general public as well as interest groups/ or people);

- Workshops with the national, provincial and district level government officials;

- Formal Ms PowerPoint Presentation (that were presented to stakeholders at the meetings);

- Updating of the existing Issues and Concerns Log (to capture and respond to stakeholder issues and comments); and

- The use of an ESIA Non-Technical Summary (NTS) in English, Shona and Tonga.

PLEASE NOTE:
All records of the Draft ESIA engagement process have been captured and presented in *Annex F* of *Part II* of this ESIA.

Other stakeholder comments that have been received since the presentation of the draft ESIA are also included in *Annex F* of *Part II* of this ESIA.

7.4 *FEEDBACK MECHANISM*

Stakeholders are provided with various opportunities to provide responses and participate by way of structured rounds of engagement during the ESIA process. However, it is important to offer stakeholder opportunities to engage and provide feedback in-between the scheduled rounds of engagement. A structured feedback mechanism has therefore been put in place during the ESIA process to ensure that potential concerns raised by stakeholders are acknowledged and addressed in a timely, structured and culturally appropriate manner.

The establishment of this feedback mechanism has been communicated to stakeholders during the Scoping Phase, and its operations will be managed by the ERM team and their Project area sub-consultants. The feedback mechanism is structured and functions as described below:

- **Opportunities to Provide Feedback**: Stakeholders will be given the opportunity to provide comment and feedback regarding the Project for the duration of the engagement process.

- **Recording Feedback**: All input received from stakeholders, whether it be through the structured engagement process or less structured means such as discussions between the consultants and community members will be recorded *via* meeting records and the Issues Log. A summary of the Issues Log will be updated throughout the comment periods, and will be included in the Scoping and ESIA Reports which will be made publically available.

- **Generating Responses**: The ESIA team together with ZRA will review comments received and generate required responses.

- **Monitoring the Feedback Mechanism**: ERM will monitor the efficiency of the feedback and response process to ensure timeous responses.

The following feedback channels are available to stakeholders throughout the duration of the ESIA process:

- **Electronic and Telephonic Feedback**: Engagement via e-mail and telephone between stakeholders and the consulting team. E-mail addresses and telephone numbers of ERM and their in-country sub-consultants have been made available to stakeholders.

- **Direct Discussions**: Engagement directly between stakeholders and members of the consulting team.

8 *BASELINE INFORMATION*

It is important to gain an understanding of the physical, biological and social attributes of the Project Area of influence for the proposed Kariba Dam Rehabilitation Project and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is being considered.

The description of the baseline environment is essential in that it represents the conditions of the environment before the rehabilitation process commences. The description of the baseline environment therefore provides a description of the current or *status quo* environment against which social and environmental impacts of the Project can be assessed and future changes monitored.

The information presented in this *Chapter* has been collected from desktop studies and supplemented with site visits to the Project Area of influence. The objective of primary data is to address data gaps identified during the secondary data collection process.

This *Chapter* describes the physical, biological and social characteristics of the receiving environment. The chapter is organised as follows:

- **Physical Environment**:
    - Physiography;
    - Geology;
    - Soils;
    - Climate; and
    - Hydrology.
- **Biological Environment**:
    - Terrestrial Flora;
    - Terrestrial Fauna;
    - Levels of Habitat Modification;
    - Aquatic Ecology; and
    - Protected Areas.
- **Social Environment**:
    - Social Area of Influence;
    - Governance and Administrative Structure of Zambia and Zimbabwe;
    - Land Tenure and Land Use;
    - Demographic Profile;
    - Vulnerable Groups;

- Education;
- Health;
- Economy and Livelihoods;
- Employment Levels;
- Public Infrastructure and Services;
- Energy; and
- Cultural Heritage.

PLEASE NOTE:

This *Chapter* does not present baseline conditions for the existing Air Shed and Noise Environment. The *status quo* atmospheric and noise baseline in the Project Area is currently influenced by activities associated with the upgrading of the Kariba South Bank Power Station. Moreover, because the proposed Project is situated in a valley away from sensitive human receptors it was decided that atmospheric and noise emissions associated with the proposed Project are unlikely.

However, the ESMP (*Part III* of this ESIA) does include provisions for the management of general atmospheric and noise emissions that are associated with construction activities. In addition, the ESMP makes provision for a grievance mechanism, which will be used by communities in the area surrounding the Project Area to voice any concerns they may with the Project (including air quality and noise concerns).

8.1 PHYSICAL ENVIRONMENT

8.1.1 Physiography

The Zambezi River Basin is located in Southern Africa and drains an area of almost 1.4 million square kilometres extending across eight countries; Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe (*Figure 8.1*). It covers almost all of the territory of Malawi, over 70 percent of Zambia and almost half of Zimbabwe and is the fourth-largest river basin in Africa.

The river rises at an elevation of over 1,500 metres above sea level in the high plateau between Zambia and the Democratic Republic of Congo (DRC), and flows for a distance of some 2,700 km to where it enters the Indian Ocean about 250 km north of Beira in Mozambique.

The middle Zambezi flows through a series of narrow gorges and fault-defined valleys and has been extensively modified by two hydroelectric dams, namely Kariba and Cahora Bassa. Together, these two dams have inundated more than half of the length of the main river. Floodplains are limited, there are no extensive wetlands, and the ecology of the river is now dominated by the regulating effects of the dams (Timberlake, 1997). At present, the generation of hydropower and agricultural activities are the major water users in the basin and it is believed that agriculture could become increasingly important in terms of water consumption in the future (Beck, 2010).

The Zambezi annual runoff at Kariba comes from a 664,000 km^2 catchment area. Upper catchment, upstream of Victoria Falls, accounts for 76 percent of it. Lower catchment, between Victoria Falls and Kariba dam, has a more irregular run-off pattern. The cumulative net inflows over the last 50 years have varied over a wide range of 15 to 94 km^3 with an average of 43 km^3 per year. Evaporation from the 5000 km^2 reservoir surface is estimated at around 8 km^3 per year.

Figure 8.1 Zambezi River Basin

Source: Zambezi River Basin: Atlas of the Changing Environment (SARDC, 2012)

8.1.2 *Geology*

The Zambezi escarpment is an extension of the Rift Valley and the present day Kariba Dam. The Kariba Dam covers the section of the Rift Valley known as the Gwembe Trough. The steep sided escarpment is composed of Pre Cambrian gneisses, paragneisses and schizts, rising over 500 m above the floor of the valley. The geology of the flat valley floor is predominantly Karroo sediments (sandstones, grits, and mudstones) with isolated patches of basalt downstream of Chirundu. Lining the Zambezi River are alluvial deposits, and further inland (where some of the larger tributaries exit the escarpment) there are alluvial fans and superficial (colluvial) deposits.

The Kariba Gorge is a narrow (200 m wide), straight, steep sided gorge of approximately 22 km length. At a point known as Nyamuomba, the gorge opens out into the valley floor and the Zambezi River changes from a fast flowing river into a wider, slower one with sandy islands and braided channels. Downstream of Chirundu the Zambezi River widens further and enters the flood plain area of Mana Pools.

Directly downstream of the Kariba Dam, the north and the south bank of the Zambezi River are dominated by sheared and weathered metasedimentary rocks of the Katanga Supergroup. However, the south bank (on the Zimbabwean side) is overlain by steeply dipping micaceous quartzites whose structural integrity deteriorates downstream (Porada & Berhorst, 2000; Knill & Jones, 1965). The main foliation and lithological trends associated with the Kariba Dam wall are orientated north-west to south-east (Knill & Jones, 1965). Approximately 20 km downstream of the Kariba Dam wall, the river broadens out as the course of the Zambezi River cuts through the rocks of the Katanga Supergroup, and floods out into the downward faulted graben of the Neoproterozoic Zambezi Belt (Interconsult, 1985), which consists of strongly deformed and resistant basement gabbro-anorthosite intruded gneisses.

The Zambezi River in the area of the plunge pool is lithologically constituted by good quality biotite gneiss. Ground investigations of a core drilled down to 72 m in the middle on the riverbed, downstream of the actual plunge pool scour hole, appears constituted by generally good quality biotite gneiss. This area is quite heterogeneous lithologically in the sense that it has massive passes of quartz-rich material alternating with weaker ferromagnesian micaceous minerals (biotite). However, within the first weathered nine metres, the rock quality designation (RQD) [(1)] for the foundation rock is fair to good (Tractebel Engineering France / Coyne et Bellier, 2014).

The top upstream edge of the plunge pool is intersected by a major north east trending fault with subsidiary parallel faults dipping 70° to 80° towards the north west. These shear planes, filled with soft infilling as the major structures show an aperture of about 15 to 20 cm. Their occurrence is only up to an elevation of 356.6 m (Tractebel Engineering France / Coyne et Bellier, 2014).

(1) The RQD is a rough measure of the degree of jointing or fracture in a rock mass.

Other shear planes extend along the right edge of the plunge pool with attitudes of 110°/90° and 320°/70° to 80°. Some ten meters downstream three other parallel faults with 15 to 20 cm soft infilling and with similar attitudes have been mapped (Tractebel Engineering France / Coyne et Bellier, 2014).

8.1.3 Soils

The escarpment and sides of the Kariba Gorge are covered in very shallow gravelly and rocky soils (skeletal soils). Further down the side of the gorge, the soils become colluvial and are deeper, reaching to the alluvial deposits along the banks of the Zambezi River.

The Zambezi Valley floor is a mosaic of sandy (siallitic) soils interspersed with areas of clay and sodic / saline deposits.

The alluvial soils along the Zambezi River are a complex of varying deposits of age, depth, texture and colour that mirror the past alterations in the river channel.

8.1.4 Climate

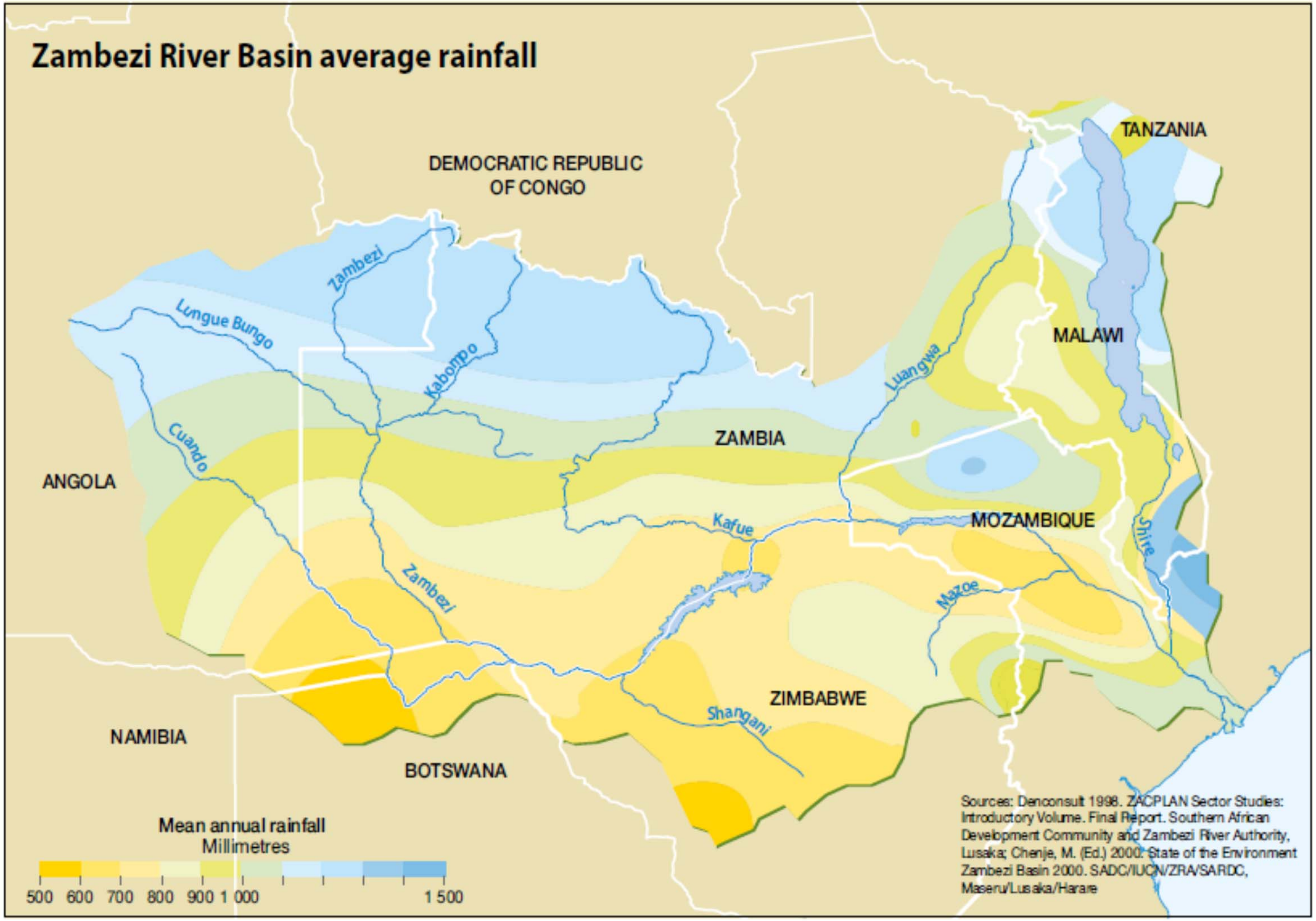
The climate of the Zambezi River Basin is typically sub-tropical (i.e. the climate is influenced by the annual movement of the Inter-tropical Convergence Zone [ITCZ]), with the following seasonal patterns:

- A hot season from late August through the beginning of the main rains;
- A main rainy season, lasting from October/November through to March/April;
- A post rainy (transitional) season in April/May; and
- A cool season from June through to early August.

The main rainfall season (or austral summer) is generally longer in the northern-most extremities of the basin, and can last for up to six months; whereas, the southern-most extremities can be as short as four months. The cool season (or austral winter) is generally characterised by dry weather across the entire basin, although some rainfall can occur in southern and eastern areas as a result of an influx of cool maritime air (known as the *Guti* in Zimbabwe, and *Chiperone* in Malawi).

Rainfall is higher in the northern parts of the basin (i.e. the upper highland reaches and the areas around Lake Malawi/Niassa/Nyasa) and can reach levels of up to 1,400-1500 mm per year, and lowest in the southern parts of the basin, (e.g. within Zimbabwe), where it can fall to 500 mm per year (*Figure 8.2*). In the upper catchment above Victoria Falls there is a general gradation of mean annual rainfall from 1,500 mm in the north to 700 mm in the south near the Chobe Swamps. Average rainfall intensities are typically of the order of 35 mm per hour due to the predominance of convective storms, and can reach as high as 70 mm per hour for short periods in severe storm conditions (Batoka HES Feasibility Study, BJVC, 1993).

Figure 8.2 Zambezi River Basin Average Rainfall



Source: Zambezi River Basin: Atlas of the Changing Environment (SARDC, 2012)

Average temperatures in the Zambezi Basin vary with elevation. During the cool season mean temperatures can fall to 13^{0}C in the higher elevation areas in the south of the basin, and overnight ground-frosts can occur. Mean daily temperatures during the warmest months can reach 31^{0}C in the lower reaches of the Zambezi Valley, and around 23^{0}C in the higher elevation areas. Correspondingly, mean annual evaporation is highest in a belt running east-west across the basin, varying from about 200 mm per month in the October to March period, and 125 mm per month in the cooler months of June and July.

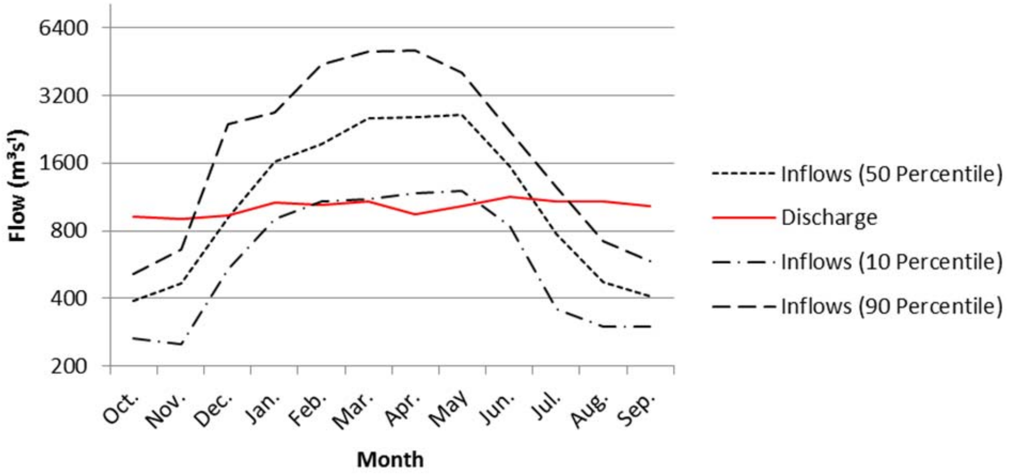
8.1.5 Hydrology

The Kariba Dam inflows provide a sound basis for inferring reference flow durations for the relevant reach of the Zambezi River downstream of the Kariba Dam wall (*Figure 8.3*). Reference flows reflect seasonal variation with typical peaks during February, March and April, while lower flows used to be experienced during September, October and November. The flow duration curves also indicate relatively large variation in reference peak and low flows, as shown by the differences between the 10th, 50th and 90th percentiles for the 1962-2010 period. Post Kariba Dam construction flows (for the period 1993-2013) are illustrated by the red line in *Figure 8.3* and represent an artificial baseflow with a significant digression from the reference hydrograph.

The change in hydrology has impacted on the downslope environment by changing the flow regime, altering the sediment supply and providing a migration barrier for instream aquatic organisms. All three factors act as drivers of ecological change. The Zambezi River downslope of Kariba Dam to Chirundu has lowered its bed by 2 m and the channel has widened between Kariba and Mupata gorges with an average of 200 m. The channel bed degradation and decrease in large flood frequencies impact on downslope floodplain ecology (*Figure 8.4*) (Khan *et al.*, 2014; Mwelwa-Mutekenya, 2014). Concurrently, the channel widening coincided with spill events, as little widening occurred post 1981(Nugent, 1988; Magadza 2000; Basson, 2005). A subsequent inference is that the increase in bedload capacity is not resulting in additional erosion and that the system probably remains stable under the current discharge regime.

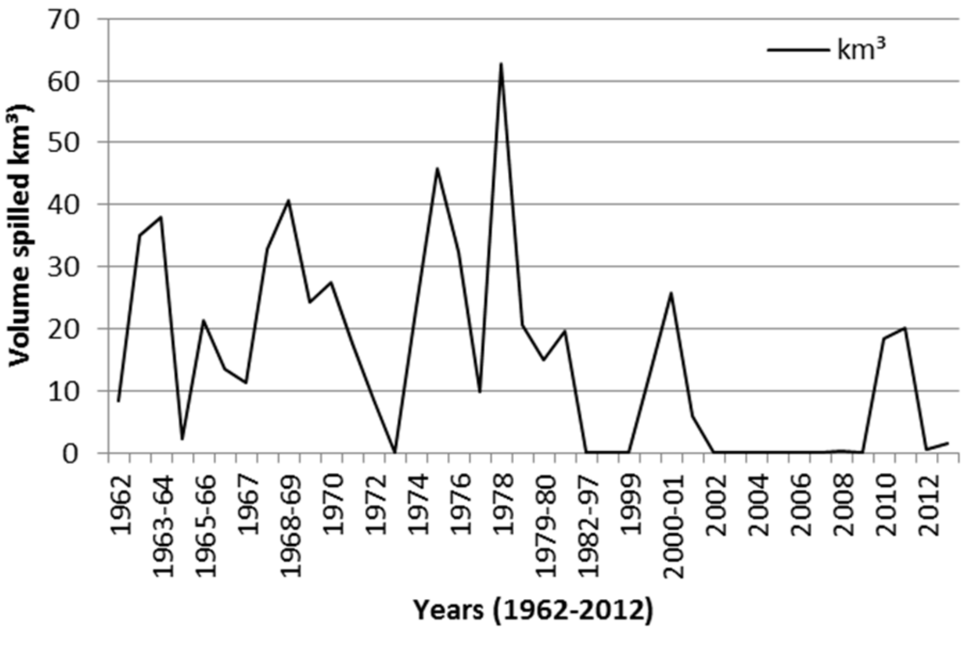
In summary, the existing flows reflect a large digression from reference flows causing altered migration cues, and a change in habitat and cover units for instream aquatic communities. Similarly, channel widening has impacted on the riparian zones and downslope floodplains and swamp areas and the processes associated with these features.

Figure 8.3 *Hydrograph Reflecting Reference (black curves) and existing (red curves) Flow Duration Curves for the Zambezi River*



Please Note: Discharge as measured through the North and South Bank Hydropower Plants.

Figure 8.4 *Graph Indicating Spill*



KEY FINDINGS – Hydrology:

The existing flows reflect a large digression from reference flow conditions, and are considered the main driver of the altered habitat and cover units for instream aquatic communities noted. Similarly, channel widening has laterally impacted on the riparian zones and downslope floodplains and swamp areas, causing a loss of these habitats due to loss of inundation in these zones. The Ecological Flow Assessment and hydraulic modelling determined boundary conditions for maintenance low flows at a flow of approximately 440 m^3/s, while drought low flows were estimated at approximately 93 m^3/s. Within the Gorge itself, large flow reductions will be more readily tolerated by the existing aquatic habitat template. However, this is unlikely to be the case downstream of the Gorge, where the habitat template will be more sensitive to flow reductions. It is thus advised that flow reduction (if required) should not exceed the maintenance low flow for extended periods of time.

8.2 BIOLOGICAL ENVIRONMENT

8.2.1 Ecological Areas of Influence

The Direct Area of Ecological Influence (*Figure 8.5*) is defined as the spillway gate construction site and the slipway upstream of the dam wall, the plunge pool and coffer dam downstream of the dam wall, the access roads and the waste rock dump site, and slipway site. The sites of sand extraction and quarries for construction materials are not included as some materials are sourced from far beyond the site, e.g. Chinhoyi and Lusaka.

The Indirect Area of Ecological Influence is defined as the Kariba Gorge from the Kariba Dam wall to Nyamuomba and downstream from there to include the upper river terraces on both sides of the river as far as the eastern boundary of Mana Pools National Park. It includes the alluvial areas in Chiawa Game Management Area and Lower Zambezi National Park in Zambia, and the alluvial areas in Urungwe Safari Area and Mana Pools National Park in Zimbabwe (*Figure 8.6*).

Figure 8.5 Direct Area of Ecological Influence

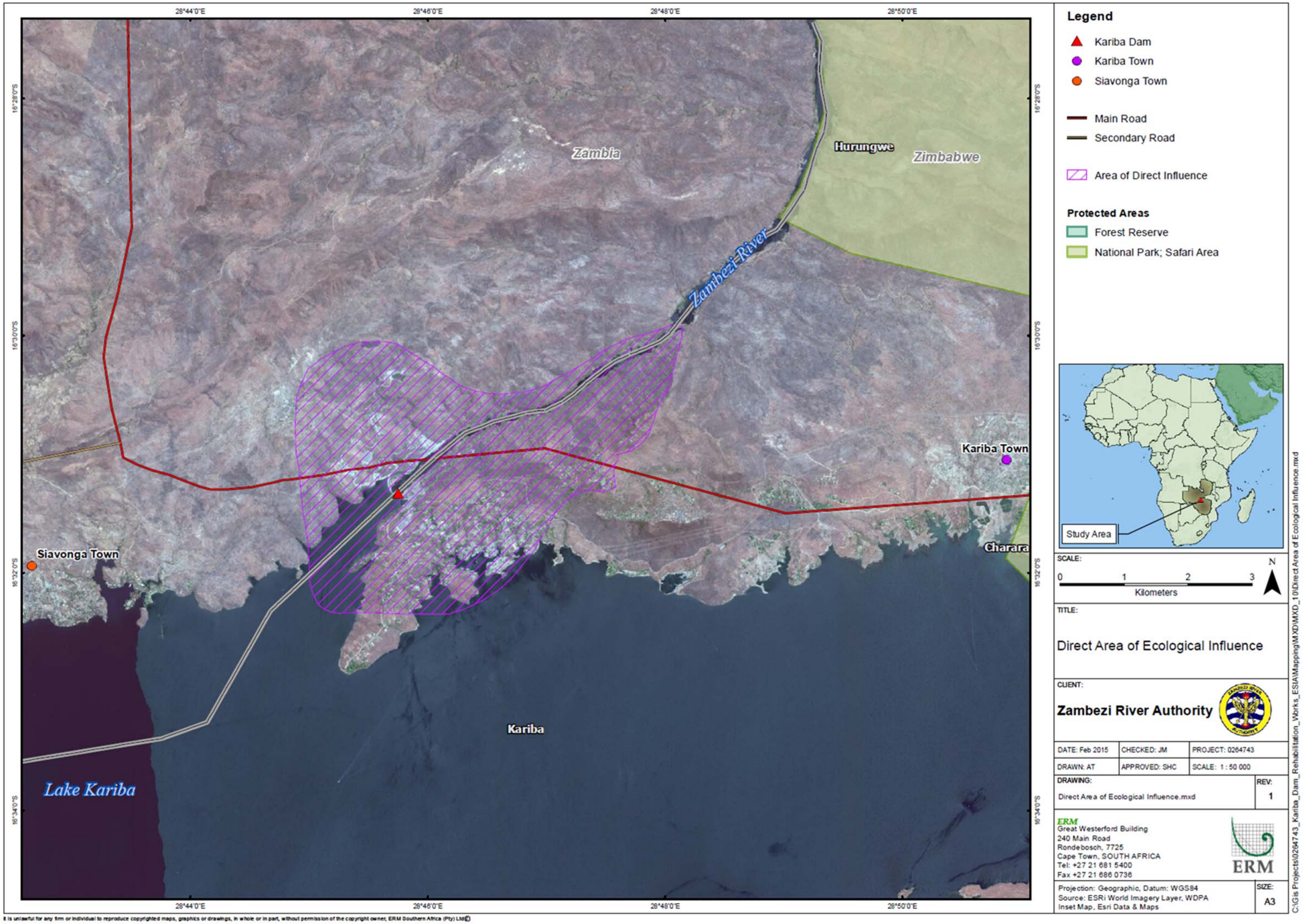
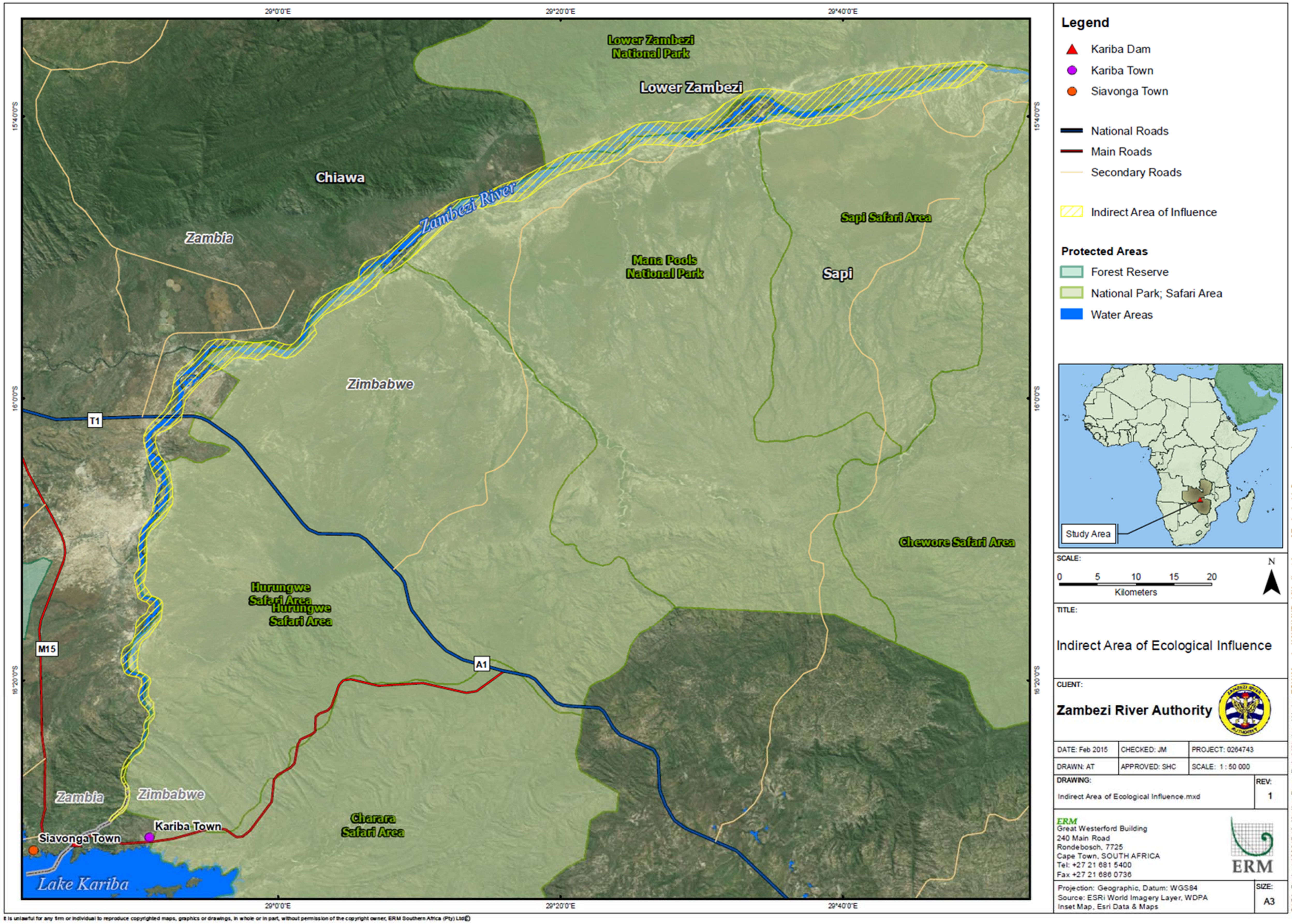


Figure 8.6 Indirect Area of Ecological Influence



8.2.2 *Terrestrial Flora*

In broad terms the Project Area is covered in woodland, the various types being dependent on the soils and other edaphic factors.

Escarpment Habitats

Generally the escarpment hill tops support open Miombo Woodland that is dominated by *Julbernardia globiflora* and *Brachystegia sp*. These hilltops grade into a Mixed Deciduous Woodland type dominated by *Kirkia acuminata, Sterculia quinqueloba* and *Commiphora sp*. further down the escarpment slopes and down the sides of Kariba Gorge. In areas where there is a high density of elephant, an increased grass cover and fuel load, coupled with late dry season hot fires, the woodland has degenerated and become more open shrubland on the Zimbabwean side. In Zambia, tree felling for firewood and construction of houses together with clearing of land for cultivation has also led to a degeneration of the woodland into open shrubland in areas around the urban centres of Siavonga and Chirundu.

Table 8.1 Important Plant Species associated with the Escarpment Habitats

Species Name	English Common Name	Local Names	IUCN Threatened Status
Acacia nigrescens	Knob Thorn	Chinanga (Shona) Isinanga / Katopa (Ndebele)	NE but common and widespread
Brachystegia sp.	Msasa (tree)	Igonde (Ndebele) Msasa / Mutatsa (Shona)	-
Caloptropis procera	Sodom's Apple		Alien invasive species
Colophospermum mopane	Mopane	Iphane (Ndebele) Mupane / Musharu (Shona) Chanye / Mpane (Nyanja)	NE but common and widespread
Combretum apiculatum	Red Bushwillow	Bonda / Tsingidzi (Shona) Umbhondo (Ndebele)	NE but common and widespread
Combretum microphyllum	Riverine flame-creeper / Burning-bush Combretum	Bambangwenya (Hlengwe) Ganwa-musero / Mupfurura / Mutsiwa Mutzutsu (Shona)	NE but common and widespread
Combretum mossambicense	Shaving brush Combretum / Knobbly bushwillow	Marorwe / Mubondorokoto (Shona)	NE but common and widespread
Commiphora sp.	Corkwood	-	-
Diospyros kirkii	Large-leaved Jackal-berry	Muchenje (Shona)	NE but common and widespread
Ficus sycamorus	Sycamore Fig	Mukuyu / Muonde (Shona) Umkhiwa (Ndebele) Mkuyu (Nyanja)	NE but common and widespread
Hyparrhenia sp.	Thatching Grass		-
Julbernardia globiflora	-	Munondo / Mutondo (Shona) Umtshonkwe (Ndebele)	NE but common and widespread
Kirkia acuminata	White Syringa	Mubvumira (Shona) Umvumile (Ndebele) Mzumba (Nyanja)	NE but common and widespread

Species Name	English Common Name	Local Names	IUCN Threatened Status
Sterculia quinqueloba	Large-leaved Star-chestnut	Kukubuyu (Shona), Umkukubuyu (Ndebele) Mgoza / Msambamfu (Nya)	NE but common and widespread
Tamarindus indica	Tamarind Tree	Musika (Shona)	NE but common and widespread

NE = Not evaluated on the IUCN Red List of Threatened Species

Waste Rock Dump Site, North Bank

PLEASE NOTE:

Chapter 6 of this report considers the key alternatives relevant to the ESIA, including siting alternatives for the waste rock dump.

"Preferred" Site for the Waste Rock Dump - Existing Disused Sinohydro Quarry

The area that was identified as the preferred waste rock dump site (refer to *Section 6.1* of this report) is in the existing disused Sinohydro quarry (refer to *Figure 8.7*) at GPS co-ordinates 16^{0}30'20.58"S 28^{0}45'45.34"E. This area was used as a quarry during the construction of the Kariba North Power Station in the 1970s and has since been abandoned. This alternative is preferred as the capacity of the quarry is large enough to accommodate almost all the excavation material (an estimated 295,000 m^3 of rock) that will be generated through rehabilitation of the plunge pool. Moreover, the site is already highly disturbed.

Figure 8.7 ***View of the Existing Disused Sinhydro Quarry (Preferred Waste Rock Dump Site)***

Source: Stuart Heather Clark / Date: 23 September 2014/ Coordinates: 16^0 30' 23.05" S; 28^0 45' 47.02" E

"Alternative" Site for the Waste Rock Dump – Immediately East of the Existing Disused Sinohydro Quarry

A second less preferred alternative waste rock dump site is located immediately east of the existing disused Sinohydro quarry at GPS co-ordinates 16°30'20.30"S 28°45'51.11"E at elevation 593 masl in an area of typical escarpment woodland (*Figure 8.8*). The alternative site is considerably less disturbed, although there were signs wood cutting and fire and the area is grazed by livestock.

Figure 8.8 *Mixed Deciduous Woodland near Sinohydro Quarry (<u>Alternative</u> Waste Rock Dump Site)*

Source: Susan Childes / Date: 24 September 2014/ Coordinates: 16^0 30' 26.05" S; 28^0 45' 40.16" E
Note: photo taken late dry season and trees are leafless.

As is mentioned in *Section 8.1.2,* the underlying geology for both sites is gneissic rock with very shallow, sandy and gravelly soils. Dominant woody species include *Julbernardia globiflora, Combretum apiculatum* and *Diospyros kirkii*. Grasses were only identified to genus level, including: *Hyparrhenia sp., Aristida sp.* and *Schmidtia sp.* No rare or endangered plant species were noted. Weedy species such as *Caloptropis procera* were noted, also indicative of disturbance.

"Alternative" Site for the Waste Rock Dump – Ephemeral Stream Adjacent to Access Road

A third less preferred alternative waste rock dump site is located at GPS co-ordinates 16°30'24.72"S 28°45'37.20"E and elevation of 567 masl. This stream drains from the high ground north and west of the quarry site down a ravine to empty into the Zambezi River just downstream of the north bank turbines. The area is a typical example of tributary riparian woodland. The stream bed was dry at the time of sampling but judging from the structure and nature of its banks, is subjected to periods of high flows of short duration. The stream is fringed by a narrow strip of tall (10-12 m) *Ficus sycamorus, Acacia nigrescens* and *Tamarindus indica* trees with an understorey of *Combretum mossambicense* shrubs and *Combretum microphyllum* creepers. No rare or endangered plants were found at the site although these may occur further down the ravine (see *Table 8.3* on *Page 8-20*) and in other patches of this woodland type elsewhere along the Kariba Gorge.

Preferred Slipway Site

PLEASE NOTE:

Chapter 8 of this report considers the key alternatives relevant to the ESIA, including siting alternatives for the slipway site.

The area that was identified as the preferred slipway alternative site (refer to *Section 8.2* of this report) is located on Zimbabwe Parks and Wildlife Management Authority (ZPWMA) land, immediately below the office and housing complex at Peter's Point, at approximate GPS co-ordinates 16°31'52.59"S 28°45'33.60"E. The area constitutes an existing slipway that is used by both ZPWMA and District Development Fund (DDF) as a boat launching site and workshop. Consequently, there is a high level of disturbance and little natural terrestrial vegetation remaining on the site. The access road to the site passes through typical Mixed Deciduous Woodland, co-dominated by *Combretum*, *Sterculia* and *Commiphora* species with some *Colophospermum mopane (Figure 8.9).*

Figure 8.9 ***Vegetation Adjacent to Slipway at Peter's Point***

Source: Susan Childes / Date: 24 September 2014/ Coordinates: 16°31'52.59"S; 28°45'33.60"E
Note: Green trees are *C. mopane*, pale whitish trees are *Sterculia*. No riparian fringing vegetation.

Valley Floor Habitats

The predominant vegetation type is *Colophospermum mopane* Woodland on the heavier soils, with patches of "jesse", a dry forest /dense thicket community of *Combretum* and *Acacia* shrubs with tall emergent *Xeroderris stuhlmannii* and *Pterocarpus lucens* trees on the deep sandy soils (*Figure 8.10*). Although the jesse thickets are markedly deciduous, they are highly productive areas, providing refuge and browse to a variety of wildlife. The important plant species in this habitat are listed in *Table 8.2*.

Figure 8.10 Typical Colophospermum mopane Woodland on Clay Soils, Zambezi Valley

Source: Stuart Heather-Clark / Date: 25 September 2014/ Coordinates: Unknown
Note: Dried out pan and spoor of wildlife.

Table 8.2 Important Plant Species associated with the Valley Floor Habitats

Species Name	English Common Name	Local Names
Acacia nigrescens	Knob Thorn	Chinanga (Shona) Isinanga / Katopa (Ndebele) Mkunku / Nyamamponombwe (Nya.)
Acacia robusta subsp. *clavigera*	Splendid thorn	Umgamanzi / Umhlabunga (Ndebele)
Combretum imberbe	Leadwood	Monzo / Mutsviri (Shona) Umtshwili (Ndebele) Chilusa /Nyonja (Nyanja)
Diospyros mespiliformis,	African ebony /Jackal Berry	Mchenja / Mvimbe (Nyanja)
Faidherbia albida	Ana-tree / Apple-ring	Musangu / Musenga (Shona) Umpumbu (Ndebele) Nsangusangu / Mtubetube (Nya.)
Kigelia africana	Sausage Tree	Mubveve /Musonya / Muvhumati (Shona) Umvebe (Ndebele)
Ludwigia sp.	Aquatic plant	-
Panicum repens	grass	-

Species Name	English Common Name	Local Names
Philenoptera violacea *[Lonchocarpus capassa]*	Apple Leaf / Rain Tree	Mumerafodya (Shona) Ichithamuzi (Ndebele) Chimpakasa (Nyanja)
Phragmites sp.	Reeds	-
Tamarindus indica	Tamarind	Museka (Shona)
Trichilia emetica	Natal Mahogany	Muchichiri (Shona)

Alluvial Soils: Sandbanks, Islands and Riparian Habitat

The alluvial soils are a complex mixture of loose sands, and layers of silt and clays of variable thickness and depths. There is a succession of vegetation types as one moves from the Zambezi River up a series of river terraces and four fairly distinct types determined by the physical composition, age and height above the Zambezi River can be distinguished (Muller & Pope, 1982 in du Toit, 1982):

- The most recently deposited alluvium are clean white sands with thin bands of grey silt that edge the present river channel. These form sandbanks and sandy islands that become colonised by semi aquatic vegetation such as *Ludwigia sp.*, *Panicum repens* and *Phragmites* reeds (*Figure 8.11*). In the drier areas, moving away from the water's edge, *Vetiveria* grass predominates.

- *Faidherbia (Acacia) albida* Woodland which colonises the relatively loose sandbanks and lower unstable river terraces (*Figure 8.12*). It comprises almost pure stands of *F. albida* trees of variable ages with no understorey of woody plants.

- *F.albida* Dominated Woodland is developed from the previous type and has other tree species such as *Trichilia emetica, Kigelia africana and Philenoptera violacea (Lonchocarpus capassa)* present, together with patches of shrubs.

- Mixed Riparian Woodland is derived from the above type, where *F.albida* is generally absent whilst those trees adapted to heavier textured soils such as *Acacia nigrescens, A.robusta subsp. clavigera, Diospyros mespiliformis, P.violeacea, C. imberbe*, *Tamarindus indica* are present, with a well-developed shrub layer and climbers. This type has the highest flora species diversity.

Within the Kariba Gorge, the riparian woodland is a narrow strip of trees of generally Mixed Riparian Woodland (type (d)), that grades into Mixed Deciduous Woodland higher up the slopes.

Figure 8.11 Sandbanks with Riparian Thicket and Faidherbia albida

Source: Stuart Heather-Clark / Date: 25 September 2014/ Coordinates: Unknown

Figure 8.12 Grassy Channel between F. albida Woodland on River Terraces, Mana Pools National Park

Source: Internet / Date: Unknown/ Coordinates: Unknown

Cultivated, Urban and Industrial Areas

Cultivated and urban areas are zones of high disturbance and are characterised by a decrease in biodiversity and indigenous plants and an increase in weedy and invasive species.

The peri-urban zones around Siavonga and Chirundu towns, and to a lesser extent, Kariba town were observed to be mostly denuded of tree species, possibly chopped down for firewood.

On the Zambian (north) bank the alluvial areas between Nyamuomba and Chirundu are intensively cultivated. Sugar cane, bananas and a variety of vegetable crops are grown by both subsistence and commercial farmers. On the Zimbabwean bank, immediately downstream of Chirundu are patches of land that was previously under sugar cane and is now under banana plantations.

IUCN Red Data, Rare and Endangered Flora

The checklist of Zambian and Zimbabwean vascular plants (Mapaura and Timberlake, 2004) was analysed for all species recorded from the north of the country. The IUCN status of those species that are known to occur in the study area and those that are likely to occur, were examined according to the Southern African Plant Red Data Lists Database (Golding /SABONET, 2002). Given that there has not been any comprehensive survey of the flora in the Kariba Gorge, it is possible that some species may have been missed.

Table 8.3 below summarises the findings of the desktop review.

Table 8.3 IUCN Red Data Plant Species (SABONET, 2003)

Species	Growth Form (& English Name)	IUCN Threat. status	Habitat / Comment
Asplenium sebungweense	Mesic fern	LR-nt	May occur, not confirmed. Limited distribution in dry forests of Zambia and Zimbabwe
Adenia karibensis	Succulent climber	LR-nt	Endemic. Found in rocky habitat of Kariba Gorge.
Cyclantheropsis parviflora	Creeper	VU	Found in Kariba Gorge.
Rhus lucens	Shrub	LR-nt	Found in Kariba Gorge.
Euphorbia cooperi var.calidicola	Succulent	LR-lc	Found in Zambezi Valley
Afzelia quanzensis	Tree (Pod Mahogany)	LR-lc	Mixed Deciduous Woodland. Threatened by logging and wood carving; agriculture
Dalbergia melanoxylon	Tree (Zebra Wood)	LR-nt	Mixed Deciduous Woodland. Threatened by wood carving
Pterocarpus angolensis	Tree (Mukwa)	LR-nt	Escarpment / Mixed Deciduous Woodland. Threatened by logging.

Key to IUCN Threatened Status: LR-lc = Lower Risk Least Concern; LR-nt = Lower Risk Near Threatened; VU = Vulnerable

Note: These species were listed as vulnerable or of conservation concern on 1998 checklist

In Zimbabwe all Aloe species and all epiphytic orchids are Specially Protected Species (Parks and Wildlife Act Chapter 20:14, 1996).

Figure 8.13 Leaves of Adenia karibaensis (left) and Leaves and Fruit of Cyclantheropsis parviflora (right)

Source: B Wursten, Zimbabwe Flora website (http://www.zimbabweflora.co.zw/speciesdata/species.php?species_id=141070)

8.2.3 Terrestrial Fauna

There are two contrasting land uses between the Zambian and Zimbabwean sides of the river and this is reflected in the animal populations. This report only examines the wild life and does not include any domestic animals.

With the exception of the immediate surrounds of the dam wall, and around Chirundu town, the entire stretch of river from Kariba to Mupata Gorge in Zimbabwe is Parks Estate, where all wildlife is protected, and can only be hunted under licence in one of the Safari Areas. Wildlife populations on the Zimbabwean bank are generally healthy and there is a high diversity of species.

In contrast, the section of Zambian riverbank from the dam wall to south of the Kafue River is open land and there is widespread agriculture. Wildlife habitat is reduced and there is human wildlife conflict, particularly with crop raiding elephant and hippopotamus. The wildlife populations in Lower Zambezi National Park and Chiawa Game Management area are contiguous with those in Mana Pools, Zimbabwe and there is undoubtedly movement of the larger animals across the border and between the two National Parks. Both countries are experiencing high poaching pressure, especially for ivory.

Large Mammals

Focal Species

Hippopotamus: Since hippopotamus are closely associated with the riparian habitat, these animals are affected by changes in river flow as flooding or drying out of the sandbanks will alter the availability of grazing. Hippos are fairly sedentary and form family units or pods that are fiercely defended by the breeding male. Territorial conflicts between rival males occur under times of stress due to food shortage or loss of habitat.

A combined boat and aerial survey by Fergusson in 2006 gave a population estimate of 3654 adult hippo for the section of river from Nyamuomba to Kanyemba. The greatest proportion of these (81.75 %) are found in the protected areas.

Elephants: Elephants are much more mobile, moving inland away from the river during the rains, returning to the river when the smaller rivers and pans dry out in winter. As with many other animals, they feed extensively on the *F. albida* pods on the Mana Pools floodplain during the late dry season.

IUCN Red Data Species and CITES Species

Table 8.4 IUCN Red Data List Species, Specially Protected Species and CITES Species

Family	Species	Common Name	IUCN Threat. Status	Specially Protected Species	CITES Appendix Species
MANIDAE	*Smutsia (Manis) temmincki*	Pangolin	VU	Both	Yes
CANIDAE	*Lycaon pictus*	African Wild Dog	EN	Zambia	Yes
FELIDAE	*Acinonyx jubatus*	Cheetah	VU	Both	Yes
FELIDAE	*Panthera leo*	African Lion	VU		Yes
FELIDAE	*Panthera pardus*	Leopard	NT		Yes
FELIDAE	*Felis silvestris*	Wild Cat	LC		Yes
HYAENIDAE	*Crocuta crocuta*	Spotted Hyaena	LC		
HYAENIDAE	*Proteles cristata*	Aardwolf	LC	Both	Yes
MUSTELIDAE	*Mellivora capensis*	Honey Badger	LC		
BOVIDAE	*Kobus ellipsiprymnus*	Waterbuck	LC		
BOVIDAE	*Syncerus caffer*	African Buffalo	LC		
HIPPOPOTAMIDAE	*Hippopotamus amphibius*	Hippopotamus	VU		Yes
ELEPHANTIDAE	*Loxodonta africana*	African Elephant	VU		Yes

Key to IUCN Threatened status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Lower Risk / Least concern
Key to Protected Species: Zambia implies protected in Zambia; Both implies protected in Zambia and Zimbabwe

Of the 13 mammal species on the IUCN Red Data List, three are listed as Specially Protected Species under the Zimbabwe Parks Act (1996) and four under Zambian legislation. Nine species are also protected under the Convention for International Trade in Endangered Species (CITES) which controls the export of these animals and their products.

Small Mammals

Small mammals that are reported to occur within the riparian zone of the Zambezi are rodents such as Canerats (*Thryonomys swinderianus*) and Water rats (*Dasymys incomtus*) that inhabit dense reed beds and semi aquatic grasses.

Although primarily associated with evergreen forests, Sun squirrel (*Heliosciurus rufobrachium*) were reported to occur in the riverine forest fringes on the Zambian bank of Lake Kariba (Smithers, 1983) and in isolated patches of riverine thickets and forest on the Zimbabwean bank, along the Ruckomeche river (K.Dunham, pers.comm).

Samango monkeys (*Cercopitecus albogularis*) are known to occur on the riverine forest fringing the Zambian bank near Mupata Gorge (own observation).

Reptiles

Python natalensis (P. sebae). The Southern African Python is a Specially Protected Species in Zimbabwe. It frequents riparian habitats and rocky outcrops.

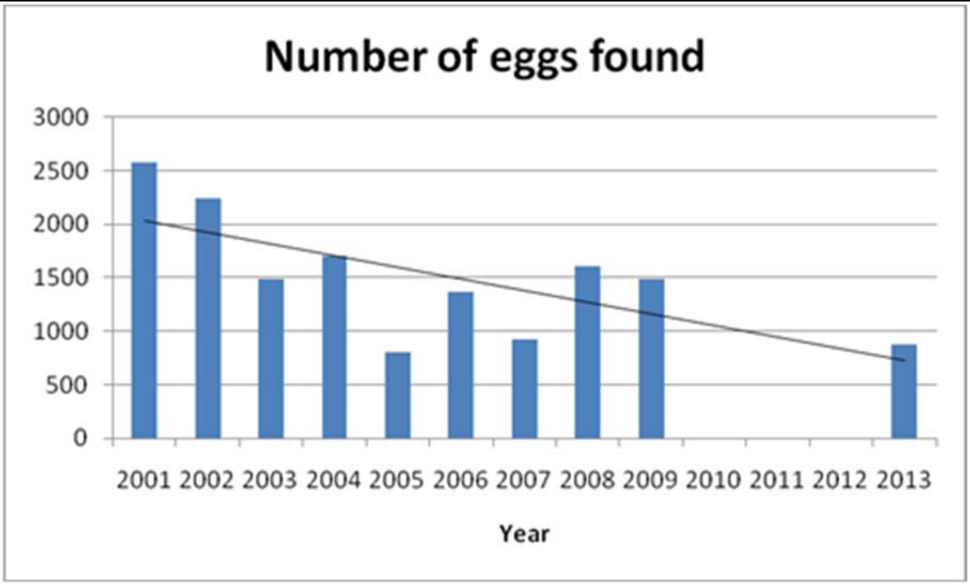
Varanus niloticus (Nile Monitor) and *V. albigularis* (Savanna Monitor) both occur in the project area. These are listed species on Appendix 2 of CITES.

Pelusios subniger (Pan hinged Terrapin) and *P.sinuatus* (Serrated hinged Terrapin) are largely aquatic, only coming onto land to nest and sunbathe. The Pan Terrapin, as its name suggests, is associated more with the inland pans, whilst *P.sinuatus* is commonly found along the river banks.

Crocodylus niloticus (Nile Crocodile) occur throughout the Zambezi River system and is an apex predator in the aquatic and riparian zone, feeding on fish, mammals and birds.

In Zimbabwe, crocodiles are listed on CITES Appendix 2, meaning that export trade is regulated and monitored. In keeping with the concept of conservation through sustainable utilisation, crocodile eggs are collected in Zimbabwe under a Parks and Wildlife Management permit for the section of the river from Kariba Dam wall downstream to the western boundary of Mana Pools National Park. The numbers have declined in recent years due to changes in collection effort and the increase in human disturbance (refer to *Figure 8.14*). Crocodiles are caught in fishing nets and their nests are raided by local villagers.

Figure 8.14 *Crocodile Egg Collection from Kariba to Mana Pools (Zimbabwean Bank) 2001-2013*



Source: Crocodile Farmers Association of Zimbabwe

There were no collections undertaken for the years 2010-2012, but the data still show a decline in numbers.

Fergusson's estimate for crocodiles from Nyamuoba to Kanyemba was 1984 animals, of which 90.6% were found in the protected areas.

Amphibians (Frogs)

Frogs are one of the most vulnerable groups to pollution and habitat change and are therefore useful bio-indicators. Frog skin is highly permeable to water and hence any dissolved chemicals. Since the early part of their life cycle is aquatic and the adult stages more terrestrial, frogs are affected by changes in both environments. Frogs eat a wide variety of invertebrates and in turn are an important food source for a range of other predators.

The frog species in this section of the Zambezi River have not been well documented but the following information was obtained from a professional natural history guide, I Riddell (see *Table 8.5*) in conjunction with a review of du Preez & Carruthers (2009). Riddell recorded a total of 21 species from the Zambezi Valley in general, of which 12 were found at Rifa Camp and 14 species at Mana Pools. None of these are considered to be endangered or threatened, although habitat loss and potential pollution from agriculture on the Zambian bank will undoubtedly have a negative impact.

Table 8.5 Checklist of Frogs Recorded in the Middle Zambezi Valley

Species (and Common Names)	Rifa Camp	Mana Pools	Zambezi Valley
Xenopus laevis (Common Platanna)	•	•	•
Phrynomantis bifasciatus bifasciatus (Banded Rubber Frog)	•		•
Hemisus marmoratus (Marbled Snout-burrower)	•	•	•
Hemisus guineensis broadleyi (Guinea Shovelnose Frog)			•
Arthroleptis stenodactylus (Common Squeaker)			•
Pyxicephalus adspersus edulis (African Bullfrog)		•	•
Tomopterna cryptotis (Common Sand Frog)			•
Tomopterna marmorata (Marbled Sand Frog)			•
Hildebrandtia ornata ornata (Ornate Frog)			•
Ptychadena anchietae (Plain Grass Frog)	•	•	•
Ptychadena mascareniensis (Mascarene Grass Frog)		•	•
Ptychadena mossambica (Broad-banded Grass Frog)	•	•	•
Phrynobatrachus natalensis (Dwarf Puddle Frog)	?	•	•
Phrynobatrachus mababiensis (Snoring Puddle Frog)	•	•	•
Chiromantis xerampelina (Foam Nest frog)	•	•	•
Kassina senegalensis (Bubbling Kassina)	•	•	•
Hyperolius marmoratus marginatus (Painted Reed Frog)		•	•
Ametiophrynus (Bufo) gutturalis (Guttural Toad)	•	•	•
Ametiophrynus (Bufo) garmani (Olive Toad)	•	•	•
Ametiophrynus (Bufo) maculatus (Flat-backed Toad)	•	•	•
Schismaderma carens (Red Toad)	•		•
Total count of species	**12**	**14**	**21**

Source: du Preez & Carruthers, 2009.

Birds

With the wide range of habitats from sandbanks and mudflats to thicket, forest and woodlands, there is a great diversity of birdlife in the Middle Zambezi Valley. The river itself is a major migration route for birds moving up and down from the lowland forests and plains of Mozambique, as well as being a seasonal refuge for many species from the highlands of Zambia and Zimbabwe (Irwin, 1981).

This area qualifies for IBA status on the basis of the high avian diversity and the fact that the site is thought to hold more than 1% of a biogeographic population of congregatory waterbird and terrestrial species (categories A3 and A4, Fishpool, 1997).

Focal Species

The following table lists the number of species in each of the main groups of birds associated with the river and riparian habitat. It is drawn from the Rifa Camp checklist of Bird Life Zimbabwe (2014).

Table 8.6 Bird Species associated with the Middle Zambezi River and Riparian Habitats

Group	Number of species	Comments: diet, status, threats
Cormorants, Darter	3	Open water; fish
Herons and Egrets	16	riverbank; Frogs, fish, insects
Hammerkop (SP)	1	riverbank; frogs
Storks, Ibises, Spoonbill	12	Molluscs and other invertebrates in mudflats and water's edge, frogs, fish
Ducks and Geese	8	Aquatic plants, grasses, seeds, insects
Crakes, Moorhens, Coot	8	Insects and aquatic plants
Jacanas	2	Insects on floating waterplants.
Stilt, Painted-snipe, Water Dikkop, Pratincoles	5	Insects and other invertebrates along shoreline. Rock Pratincole breeds within the Kariba and Mupata Gorges.
Plovers, Lapwings, Sandpipers	25	Insects and other invertebrates along shoreline.
Gulls	3	Fish, frogs.
Kingfishers	8	3 of these species are mostly aquatic feeding on small fish, the others are inland species feeding on terrestrial insects
Piscivorous (fish eating) Raptors	3	Osprey is a seasonal migrant; Pel's Fishing Owls roosts and nests in dense canopy of evergreen trees along river banks
Other significant raptors associated with riparian habitat	1	Southern Banded Snake Eagle is closely associated with riparian habitat and nests in tall trees in the riverine woodlands and ravines. This habitat is under threat from clearing for cultivation on the Zambian side, and from high densities of elephants on the Zimbabwean side.
Sandbank nesting birds	3	African Skimmer. Intra African migrant. Endangered in sub region. Nests on low exposed, un-vegetated sandbanks. See text for more details. Southern Carmine Bee eater and White fronted Bee eater both nest in cliffs along riverbanks. Significant colonies along the Middle Zambezi and tributary rivers. Martins, Swifts: several species nest in the cliffs along river banks. None are threatened or endangered species.

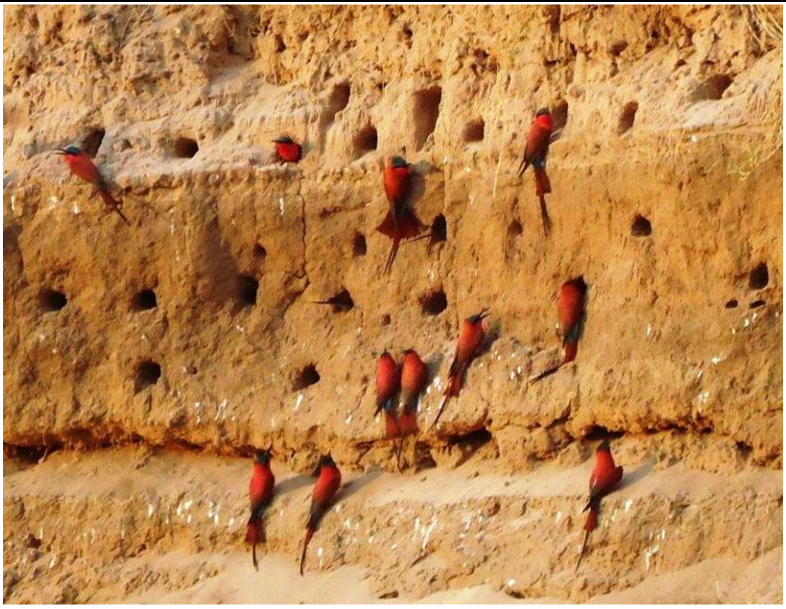
SP = Specially Protected.

Birds of Conservation Concern

Southern Carmine Bee Eater (*Merops nubicoides*)

The banks of the Zambezi provide nesting habitat for an estimated 10 000 Carmine Bee eaters which is a significant population and higher than the threshold for congregatory terrestrial species (category A4ii *sensu* Fishpool 1997).

Figure 8.15 *Southern Carmine Bee Eaters are Intra African Migrants that Nest in Sandbanks along the Zambezi River*



Source: Internet / Date: Unkown/ Coordinates: Unknown

Rock Pratincole (*Glareola nuchalis*)

These are small, fast flying birds that inhabit and nest on the exposed rocks in the middle of fast flowing rivers where there is protection from predators. Rock Pratincoles feed predominantly on emerging aquatic insect larvae, such as caddisflies, that they forage from rocks midstream and on the margins of rivers. They are found along the Zambezi River, and are known to breed in Kariba Gorge and Mupata Gorge. The impoundments of Lake Kariba and Cahora Bassa have greatly reduced the birds' habitat and the diurnal fluctuations in water levels in Kariba Gorge caused by changes in electricity generation from Kariba create a tidal effect of more than one metre which may affect the birds. The effects of human predation have not been evaluated but may be significant (Hockey *et al*, 2005).

The species is a localised, uncommon intra-African migrant that arrives late July-August and departs in December-January to non-breeding grounds in East Africa. Although it occurs elsewhere in Africa, the population in the sub region is considered to be of high conservation concern.

African Skimmer (*Rhynchops flavirostris*)

This bird is has a modified bill and flight pattern that enables it to fly just above the water, literally skimming the surface for small fish. It a localised species found on large river systems with exposed un-vegetated sandbars and islands, particularly on the Zambezi. It is partial intra-African migrant, arriving in May and departing in December. It has very specific requirements for nesting and lays its eggs on bare sand, often close to the water's edge.

Although categorised as Near Threatened (IUCN) the southern African population is now considered to be Endangered as it is decreasing rapidly due to habitat loss, exploitation and disturbance. Construction of Lake Kariba resulted in loss of breeding sites both up- and downstream of the dam wall. During breeding (dry) season, boats create wakes that wash eggs and chicks into the water. The breeding birds are also disturbed by canoeing safaris camping on islands in the Zambezi River. Eggs are collected for food by local villagers and the chicks used as fishing bait.

Population surveys along the 256 km of Zambezi River between Kariba Gorge and Kanyemba show a decline in numbers: (1981) 100; (1986/1987) 137; (1989) 56; (1991) 36 and no evidence of breeding at the last count. In Jan 1990, the pre-migratory gathering at Rukomeche, Zimbabwe, contained only 12 birds (Hockey, *et.al*. 2005).

8.2.4 Levels of Habitat Modification

This *Section* evaluates the level of disturbance to the main habitats and the natural functioning of the ecosystems.

IFC Definitions

The IFC Performance Standard 6 *Biodiversity Conservation and Sustainable Management of Living Natural Resources* classifies habitats under the following three main categories.

Modified Habitat

Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. Examples of this habitat are the urban areas around Siavonga, Kariba and Chirundu towns, as well as the cultivated fields along the Zambian bank.

Natural Habitat

Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. Excluding the immediate environs of the various safari camps, the protected areas on the Zimbabwean side of the river are good examples of natural habitats.

Critical Habitat

Critical habitats are areas with high biodiversity value, including:

- Habitat of significant importance to Critically Endangered and/or Endangered species;

- Habitat of significant importance to endemic and/or restricted-range species;

- Habitat supporting globally significant concentrations of migratory species and/or congregatory species; and

- Highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

Table 8.7 Habitat Type and Levels of Modification

Habitat Type	IFC Classification	Level of Modification	Biodiversity Value
Escarpment Habitats a) Miombo Woodland (Julbernardia-Brachystegia) b) Kirkia-Sterculia-Commiphora woodland	Natural Natural	Low – medium modification is around towns. Trees are cut for poles (housing) and firewood. Elephant damage in Zimbabwe national parks and safari areas; annual late dry season hot fires in Zambia and Zimbabwe reducing woodland to open shrubland in places	Low – medium. Type is widespread through project area and region
Valley Floor Habitats a) Colophospermum mopane woodland on heavy soils b)Dry forest / thicket "jesse" on sandy soils	Natural – some Modified Natural	Low-medium. Localised modification where elephant densities are high. Low-medium. Localised modification where elephant densities are high	Medium. Although the type is very widespread, there are some particularly good examples of cathedral mopane woodland in the Parks Estate. Medium-High. Dry forest is a restricted type with high species diversity
Alluvial Habitats a) Zambezi river sandbanks b) Zambezi river riparian woodland	Natural. Modification due to absence of natural flood patterns caused by damming of Zambezi river (Lake Kariba).	This type meets the criteria (i), (iii), (iv) listed for Critical Habitat	Very High Biodiversity Value Especially Mana Pools floodplain
Cultivation	Modified	High. Where the cultivation has been intense and long term, the level of modification is high,	Low. Wildlife species absent or in low numbers; habitats highly modified.

Habitat Type	IFC Classification	Level of Modification	Biodiversity Value
		although some ecological processes still continue, albeit at a reduced rate: e.g. nutrient re-cycling. Invasive or Weedy species are common	
Urban	Highly modified	High. Many ecological processes have been compromised, except in suburban gardens. Weedy species common.	Low although there may be more species than in cultivated areas due to the introduction of ornamental plants into gardens.

<u>KEY FINDINGS – Terrestrial Ecology</u>:

The area of direct influence around Kariba and Siavonga towns is already highly disturbed through urbanisation. The impact of the project to the local ecology is therefore not as significant as to the Kariba Gorge itself which is an undisturbed and largely natural habitat and the location of several red listed plant species.

Downstream, the area of indirect influence has two contrasting land use types and therefore different levels of habitat modification. On the Zambian bank from Nyamuomba to Chiawa, the area is disturbed through cultivation but further downstream in the Lower Zambezi National Park, the habitats are natural. The same applies to the Zimbabwe bank which has vast expanses of undisturbed natural habitats. The Zambezi River riparian habitat including the riparian woodlands within the Gorge, the sandbanks and floodplains are critical habitats for several bird species, as well a refuge for large populations of hippopotamus and crocodile.

8.2.5 Aquatic Ecology

<u>PLEASE NOTE</u>:

The results included in this *Section* are from baseline data collection during the dry season only. Wet season sampling was undertaken during the time of finalising this report and sampling results are attached as *Annex E* in *Part II* of this ESIA. The results from the wet season sampling do show some variation to those of the dry season; however, this did not influence the outcomes of the aquatic impact assessment presented in *Chapter 9*.

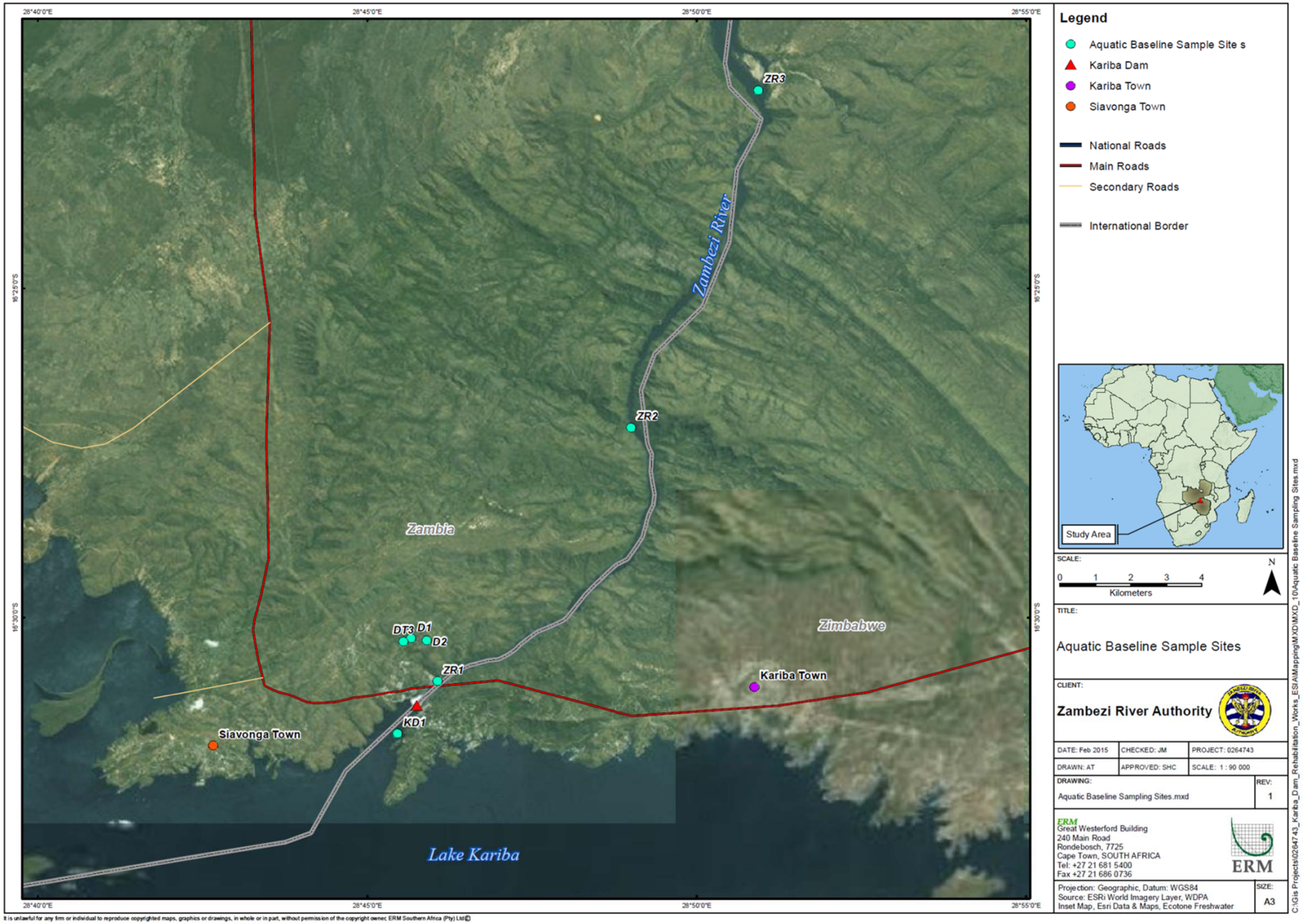
Sampling Sites

Three sites were sampled on the Zambezi River representing a 22 km stretch of river in a continuous habitat unit from downstream of the Kariba Dam wall, to the mouth of the Kariba Gorge (*Figure 8.16*). Site ZR1 is represented by the reach located directly downstream of the Dam wall. Site ZR2 is located a further 10 km from ZR1, within the Gorge, while Site ZR3 is located furthest downstream, approximately 23 km downstream of the dam wall at the end of the Kariba Gorge. Together, the three sites represent the entire available habitat within the downslope area. This stretch of River also forms a hydrological unit, as the volume contribution of tributaries in this reach is not significant. The system at site ZR3, has undergone a large slope adjustment with a large sand bank present mid-channel. Large floodplains are present on both banks; however, due to the flow regulation caused by power generation and the channel degradation experienced in the associated reach, the floodplains are no longer flooded with the same frequency.

During the reshaping of the plunge pool area, rocks, sediment and blasted material will be transported by trucks to the deposit area. The preferred alternative, the disused Sinhydro quarry, represented by site D1 is located in an existing quarry with an alternative waste rock dump site (D2) situated approximately 100 m to the east on a drainage line. An additional site (DT3) was selected for monitoring purposes on an ephemeral stream located approximately 200 m west of the disused quarry. This stream was dry during the September 2014 survey.

Site KD1 is located at an existing slipway on Kariba Dam, to the south of the Kariba Dam wall. The slipway will need to be upgraded and dredged in order for the proposed floating coffer dam to be able to enter the bay and then be transported to the dam wall via a tug boat.

Figure 8.16 Aquatic Baseline Sample Sites



Water Quality

In situ Results

In situ water quality for sites located on the Zambezi River (ZR1-3) showed slightly alkaline conditions, with low electrical conductivity (ECs) (*Table 8.8*). Site KD1, on the Kariba Dam reservoir representing the proposed spillway area showed a more alkaline condition and marginally higher salt load than sites ZR1-3 on the Zambezi River, downstream of the spillway. This most likely relates to the lentic and lotic differences between the sites assessed. Site D1, representing the preferred waste rock dump site, the disused Sinohydro quarry site, reflected hyper alkaline and saline conditions. The water in the existing quarry is contaminated, probably through geological exposure and leachate. The pending chemical results will highlight constituents of concern and identify potential toxicity risk factors associated with this water.

Table 8.8 In situ Water Quality Values Measured during the September 2014 Survey

Variable	Abb.	Unit	ZR1	ZR2	ZR3	KD1	D1
pH	-	[H^{1}+ ions]	7.8	7.8	7.6	8.3	9.3
Electrical Conductivity	EC	µS-cm^{-1}	87.0	87.6	86.9	91.6	6.5*
Total Dissolved Solids	TDS	ppm	62.1	62.8	63.2	65.7	4.6#
Temperature	Temp	°C	23.5	24.9	24	25.1	25.8

* = mS-cm^{-1}; # = ppt

	Ideal (Kotze, 2002)
	Tolerable (Kotze, 2002)
	Intolerable (Kotze, 2002)

Source: Ecotone, 2014

Please Note: tolerability describes the threshold for sustaining ecological integrity. A loss in ecosystem functioning will occur or can be expected if this threshold is exceeded.

Historical Water Quality

Data analyses for historical water quality (2009-2013) provided by the ZRA for a monitoring point immediately downstream of the Kariba Dam wall indicated circum-neutral pH values (*Figure 8.17*A). Although the median values fell within ideal threshold values for aquatic ecosystems, some minimum values for 2009 and 2013 fell below the acidic threshold for aquatic ecosystems.

Median EC ranged between 64.5 and 105.0 µs/cm and reflected a categorical annual decrease during the monitoring period. The EC range monitored was roughly comparable to epilimnotic values which range between 75 and 104µs/cm (Machena et al., 1993). The temporal range in electrical conductivities fell well within boundary conditions for freshwater aquatic ecosystems. The threshold values indicated in *Figure 8.17*B reflect the minimum and maximum values of the 85th percentiles calculated for each year, and serves as a general guide for future salt load management of the system.

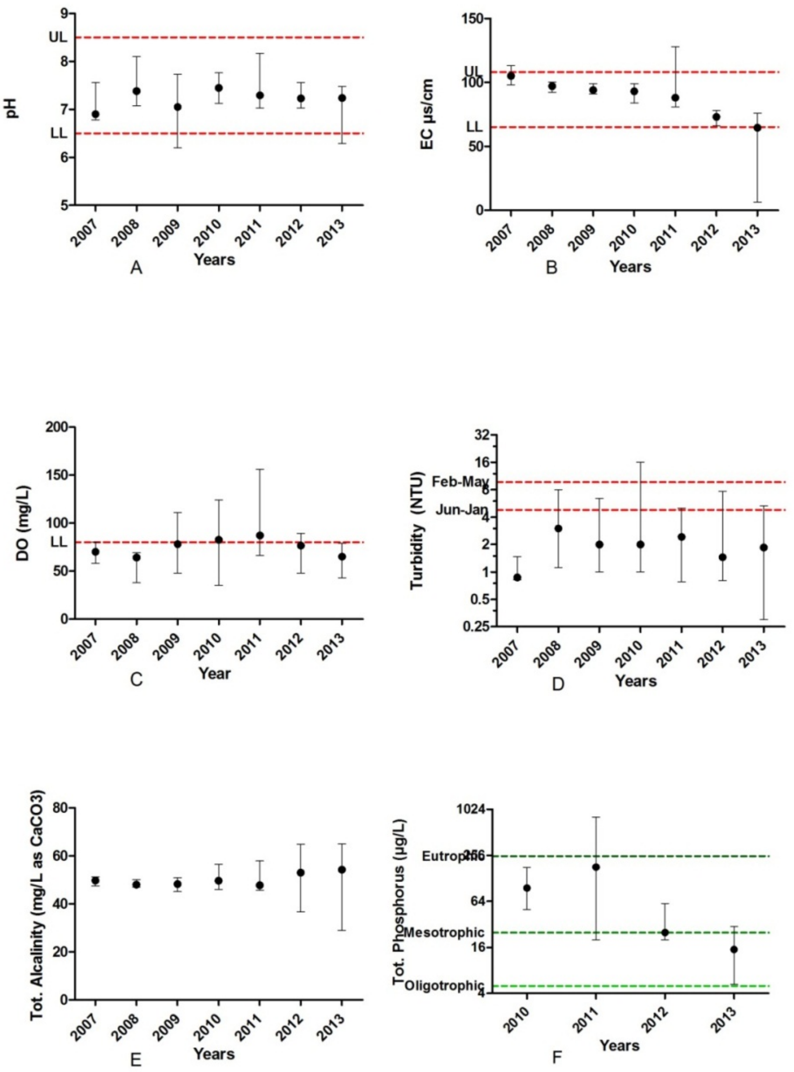
Previous studies indicated saturated and nearly saturated conditions for the epilimnion of Kariba Dam with dissolved oxygen (DO) values ranging between 7.6 and 7.8 mg/L (Begg, 1967; Machena *et al.*, 1993; Masundire, 1998 WCD, 2000). The saturation gradient correlates with a depth gradient, with shallower areas reflecting higher DO saturation. Levels measured during the 2007-2013 monitoring period, generally fell below this recorded value (*Figure 8.17*C). Median values oscillated around the recommended 80% saturation threshold for aquatic ecosystems. Prolonged exposure to levels below 80% has been associated with ecological degradation.

Turbidity levels indicated some seasonal variation which probably relates to the annual thermal mix of nutrient rich hypolimnic water. In general Kariba Dam water reflects low turbidity values due to relatively low nutrient and silt loads and thermal stratification. Thresholds turbidity values are expressed for different periods of the year (February to May, and June to January) and represent a historical median plus 10% for the two periods respectively (*Figure 8.17*D).

Median values for total alkalinity indicates a relatively large amount of temporal variation during the 2007-2013 monitoring period, although the variance has increased systematically since 2010 (*Figure 8.17*E). Other limnological assessments of the reservoir reported total alkalinity values ranging between 41 and 43mg/L (Begg, 1976; WCD, 2000).

A decrease in annual median nutrient levels, as indicated by total Phosphorus, has been measured for the 2010-2013 monitoring period (*Figure 8.17*F). The nutrient classification for water associated with the monitoring point, generally fell within the oligotrophic to mesotrophic range. This observation remains consistent with other studies which indicate total Phosphorus ranges between 0 and 72 µg/L (Begg, 1976; WCD, 2000); although, recent studies have reported increases in mean Phosphorus and Nitrogen levels. Increased nutrient levels have also been attributed to fish cage culture practices and boat usage (Mhlanga, 1994).

Figure 8.17 ***(A) Median Error Graph for pH; (B) EC; (C) Dissolved Oxygen; (D) Turbidity; (E) Total Alkalinity and (F) Total Phosphorus (measured during the period 2007 and 2013, with dashed lines indicating threshold values for water quality constituents)***



Source: Ecotone, 2014

KEY FINDINGS – Water Quality:

Water quality fell within threshold values for sustaining aquatic ecosystems. Results from the September 2014 field assessment were consistent with the water quality data provided by the Zambezi River Authority. Water from this reach was characterised by circumneutral pH values and relatively low electrical conductivities. Conversely, water sampled within the proposed rock disposal area (D1) reflected a high alkalinity and salt loads with trace elements potentially posing an ecotoxicological threat. These include Aluminium, Arsenic, Copper, Fluoride, Mercury and Selenium. Due to the possible ecotoxicological threat, any water removed from the quarry should be considered as contaminated and should not be released into the surrounding watercourses.

The analysis of sediment taken at Site KD1 indicated elevated levels of Aluminium, Calcium, Magnesium, Manganese, Sodium and Diesel Rage Hydro-carbons. These levels could pose an environmental risk; however, these elements are ubiquitous and may also be attributed to weathering processes.

Habitat Assessment

Habitat Integrity

The instream habitat integrity (IHI) assessment (Kleynhans, 1996) was applied in order to ascertain the change of instream and riparian habitat from natural conditions on a site basis. The IHI assessment provides a tool for assessing habitat by incorporating various factors and potential impacts (Kleynhans, 1996). The habitat integrity assessment revealed that the sites assessed along the Zambezi River reflected a Moderate to Largely modified state (IHI 50 - 69 %), with site ZR1 indicating the largest modification to habitat integrity (*Table 8.9*). The main contributing factors responsible for the decline in both instream and riparian habitat integrity are the flow, bed and channel modification experienced as a result of the construction of Kariba Dam and the associated power generation (*Table 8.10* and *Table 8.11*).

The sites associated with the waste rock dump site were less impacted and classed in C categories, inferring a Moderately modified state, where a loss and change of natural habitat have occurred but the basic ecosystem functions are still predominantly unchanged (*Table 8.9*). Overall IHI scores ranged from 73 – 78 % for these sites (*Table 8.12* and *Table 8.13*).

Table 8.9 Results for the Index of Habitat Integrity for Study Sites (September 2014)

Habitat Type	ZR1	ZR2	ZR3	D2	DT3
Instream habitat integrity %	43	64	51	78	72
Instream habitat integrity Class	D	C	D	C	C
Riparian habitat integrity %	59	74	62	78	76
Riparian habitat integrity Class	D	C	C	C	C
Over all IHI %	50.8	69.0	56.8	78.1	73.8
Over all IHI category	D	C	D	C	C
C	A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged				
D	Large loss of natural habitat, biota and basic ecosystem functions has occurred				

Source: Ecotone, 2014

Table 8.10 Instream Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Instream Habitat Integrity for Sites Located on the Zambezi River

Criterion	Impact Category			Contributing Factors
	ZR1	ZR2	ZR3	
Water Abstraction	**None**	**None**	**None**	Minimal water abstraction was taking place at Site ZR1.
Extent of Inundation	**Moderate**	**Moderate**	**Large**	The instream habitat is impacted due to the daily fluctuation in extents of inundation associated with the power generation. Site ZR3 experiences a greater impact due to the nature of the reach and the general slope adjustment that has taken place in the associated reach.
Water Quality	**None**	**None**	**None**	The reach indicated circumneutral pH values with low EC.
Flow Modification	**Critical**	**Critical**	**Critical**	The construction of the Kariba Dam has resulted in severe flow modification, altering the natural flow regime of the system.
Bed Modification	**Large**	**Small**	**Moderate**	The highest degree of impact was noted at site ZR1, located directly downstream of the Kariba Dam. Releases from the spillway have resulted in severe scouring of the plunge pool (± 80m).
Channel Modification	**Serious**	**Small**	**Large**	The construction of the dam wall and the subsequent alteration in flow has altered the channel characteristics resulting in a change in instream habitat, particularly at site ZR1. Site ZR3, located approximately 23km downstream, has experienced a loss in normal channel forming processes.
Presence of Exotic Macrophytes	**None**	**None**	**None**	None noted at the time of survey.
Presence Of Exotic Fauna	**Large**	**Large**	**Large**	Due to the confirmed presence of *Oreochromis niloticus*.
Presence Of Solid Waste	**None**	**Small**	**None**	Some litter was observed on the banks at site ZR2, associated with the local fisherman.

Source: Ecotone, 2014

Table 8.11 Riparian Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Riparian Habitat Integrity for Sites Located on the Zambezi River

Criterion	Impact Category			Contributing Factors
	ZR1	ZR2	ZR3	
Water Abstraction	**None**	**None**	**None**	
Extent of Inundation	**Serious**	**Serious**	**Serious**	The extent of inundation of the riparian zone in this reach is seriously impacted, especially at site ZR3. The construction of Kariba dam has resulted in the loss of seasonality with a reduction in high flows and flood events causing the associated flood benches and flood plains to become inundation less frequent. This may lead to the **terrestrialization of the riparian zone** due of a lack of prolonged flooding and fluvial deposition.
Water Quality	**Large**	**None**	**None**	Construction activities associated with the construction of the new powerhouses.
Flow Modification	**Large**	**Large**	**Serious**	The extent of the floodplain has been altered when compared to historical conditions, particularly at site ZR3, resulting in terrestrial encroachment (as mentioned above). Vegetation removal, infill and the deposition of rocks has taken place on both banks downstream of the dam wall (ZR1) due to construction related activities associated with the new powerhouses.
Channel Modification	**Serious**	**Large**	**Serious**	Infill and the deposition of rocks have taken place on both banks at site ZR1 (as mentioned above). Further downstream, at site ZR3, the channel has become more incised and widening of the channel as occurred.
Decrease in Indigenous Vegetation	**Moderate**	**None**	**None**	Construction activities and the dumping of rocks on the embankments has resulted in the loss and clearing of vegetation within the riparian zone.
Exotic Vegetation Encroachment	**Small**	**Small**	**Small**	Limited.
Bank Erosion	**Small**	**Small**	**Large**	Limited bank erosion was noted in the upper reach of the study area, however, severe bank erosion and instability was noted at site ZR3.

Source: Ecotone, 2014

Table 8.12 Instream Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Instream Habitat Integrity at Sites D2 and DT3

Criterion	D2		DT3	
	Impact Category	**Contributing Factors**	**Impact Category**	**Contributing Factors**
Water Abstraction	**None**		**None**	
Extent of Inundation	**None**		**None**	
Water Quality	**None**		**None**	
Flow Modification	**Moderate**	Clearing and infilling activities have taken place in the upper reach.	**Large**	Instream flow is impacted by a gravel road crossing with flumes that are half filled with sediment. In addition, remains of an old road crossing are present within the channel.
Bed Modification	**Moderate**	As above	**Large**	As above
Channel Modification	**Moderate**	As above	**Moderate**	Impacts associated with the road crossing and downstream bank scouring.
Presence of Exotic Macrophytes	**None**		**None**	
Presence Of Exotic Fauna	**None**		**None**	
Presence Of Solid Waste	**Small**	Limited.	**Large**	Building rubble present instream with some litter noted.

Source: Ecotone, 2014

Table 8.13 Riparian Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Riparian Habitat Integrity at D2 and DT3

Criterion	D2		DT3	
	Impact Category	Contributing Factors	Impact Category	Contributing Factors
Water Abstraction	**None**		**None**	
Extent of Inundation	**None**		**None**	
Water Quality	**Small**	Cattle faeces present to a small extent.	**None**	
Flow Modification	**Moderate**	Clearing, infilling activities and the dumping of rocks have taken place in the upper reach of the site.	**Moderate**	Roads and the removal of vegetation have resulted in moderate flow alteration.
Channel Modification	**Moderate**	As above.	**Moderate**	As above.
Decrease in Indigenous Vegetation	**Large**	Clearing and infilling activities and trampling by cattle.	**Large**	Construction of the road crossing and clearing of riparian vegetation on left associated with the small informal road running parallel to the system.
Exotic Vegetation Encroachment	**Small**	Present to a limited extent.	**Small**	Present to a limited extent. (*Sesbania sp.*)
Bank Erosion	**Small**	Mild erosion was noted in the upper reach.	**Large**	Extension erosion (scouring) was noted on both banks.

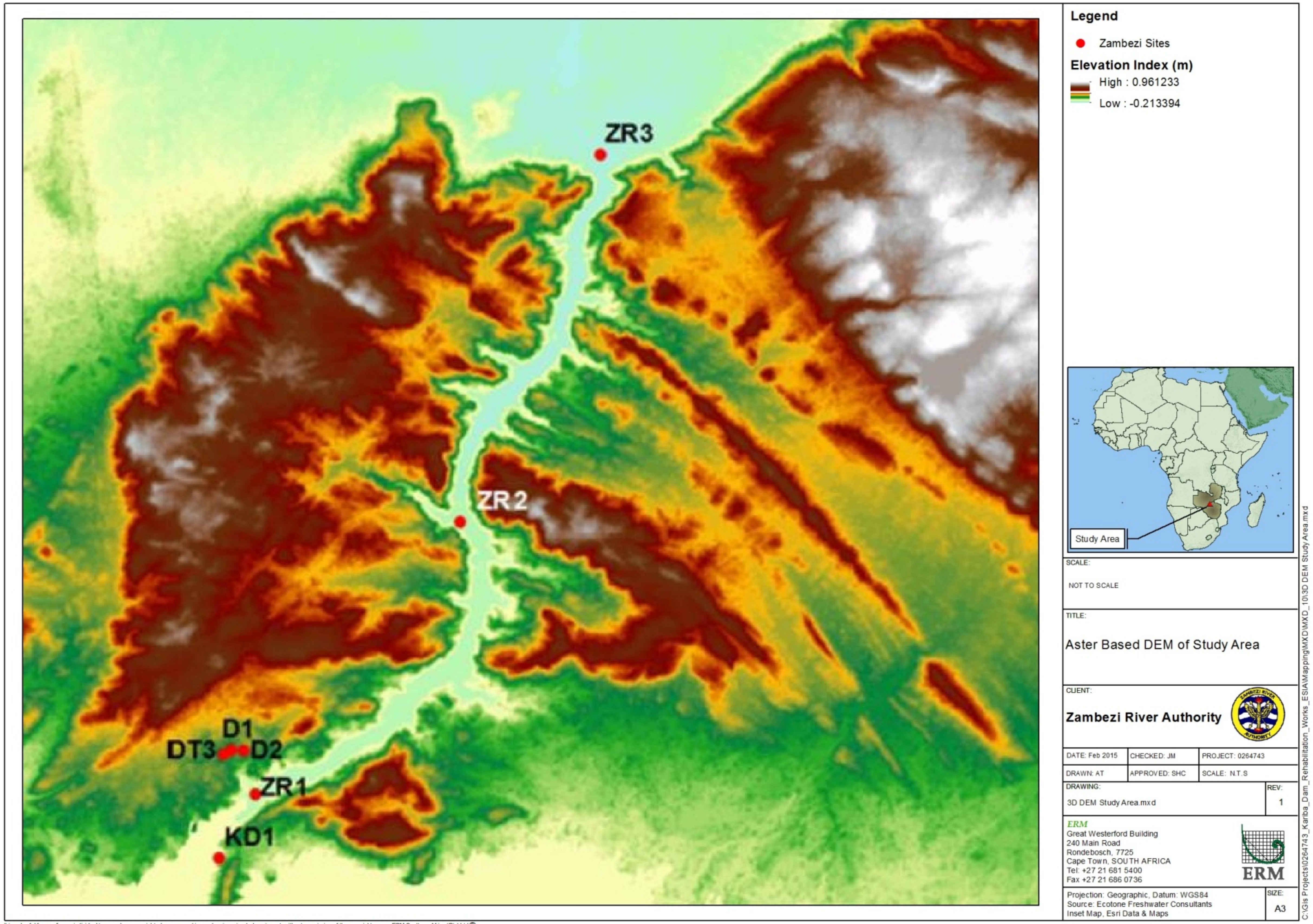
Source: Ecotone, 2014

Catchment Transformation

In addition to *in situ* habitat integrity assessment, the general river reach was also assessed in relation to its catchment and the degree of catchment transformation. The intensity of impacts associated with catchment unitisation is generally well expressed in receiving drainage systems. The DEM results indicated topographic highs directly downstream of the Kariba Dam on both sides of the Zambezi River for approximately 20km, after which the Zambezi River widens out into a low-lying floodplain to the north (*Figure 8.18*). The EVI results display relatively high vegetation indices, and subsequent high vegetation growth, on the right bank (Zimbabwean side), and moderate to low vegetation indices on the left bank (Zambian side) correlating to areas of little or no vegetation growth (*Figure 8.19*). Overall, the highest vegetation indices were observed to be associated with the riparian areas of small tributaries entering the Zambezi River, while very little riparian vegetation was notable along the Zambezi River itself, increasing only once the river passes into the downstream floodplain. The lowest overall vegetation indices were notably located on the steep south facing slopes found on both the left and the right banks of the Zambezi River. However, when comparing the EVI results to the topography, the low productivity on the left bank could not be attributed to the raised elevation alone, as the Zimbabwean side displays greater topographic highs than Zambian side (*Figure 8.18*), with overall higher vegetation indices (*Figure 8.19*).

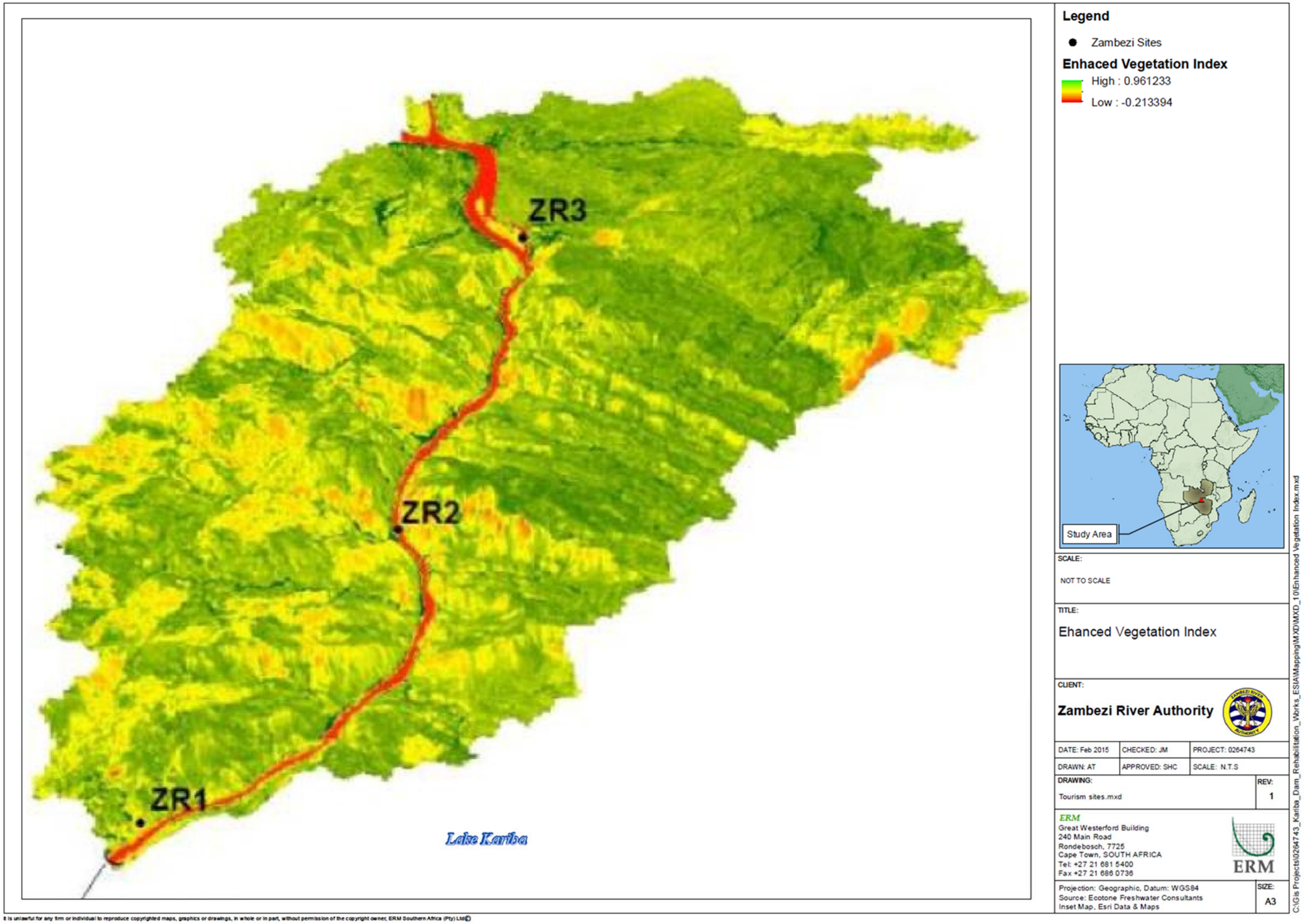
This difference in catchment transformation found on the left bank when compared to the right bank of the Zambezi River, reflects the different historic and current landuses implemented by the two countries bordering either side of the River. The landuse on the Zimbabwean side of the Zambezi River constitutes national parks and nature reserves along most of the length of the middle Zambezi. While on the Zambian side, up to the downstream confluence of the Chongwe River, landuse is dominated mostly by subsistence farming, rural developments and pastoral activities. This elevated landuse puts pressure on the left bank and results in increased surface denudation and subsequent soil erosion and runoff. It could be concluded that any large volumes of sediment input into the Zambezi River downstream of the dam wall would originate predominantly from the catchment region associated with the left bank. Although generally more sparsely vegetated, most of the southward facing slopes in *Figure 8.19* indicated higher vegetation indices on the Zimbabwean side than on the Zambian side, suggesting a higher overall catchment transformation on the left Zambian bank.

Figure 8.18 ASTER Based 3D DEM of the Study Site (NASA Landsat Program, 2014)



Source: Ecotone, 2014

Figure 8.19 Enhanced Vegetation Index of the Downstream Reaches of the Kariba Dam (USGS Landsat 8 scene LC81710712014231LGN00, 2014)



Source: Ecotone, 2014

Macroinvertebrate Habitat Availability

Sites assessed showed an Adequate to Poor macroinvertebrate habitat availability in the September 2014 survey (*Table 8.14*). Site ZR1 reflected the lowest habitat availability for macroinvertebrate colonization, lacking both aquatic and marginal vegetation and riffle/rapids section. Marginal and aquatic vegetation was more readily available in the lower reaches. Site ZR2 obtained the highest habitat availability score and was classed as Adequate.

Table 8.14 Invertebrate Habitat Assessment System Version 2 (IHAS v.2) Scores for Sites assessed during September 2014

	ZR1	ZR2	ZR3
Stones in Current	15	19	14
Vegetation	0	16	17
Other Habitat	11	17	15
Total IHAS (%)	35.1	70.3	62.2
Class	Poor	Adequate	Poor

Fish Habitat

In general, available fish habitat was dominated by fast-deep and slow-deep flowing water, with substrate and water column being the most dominant cover unit at all sites assessed (*Table 8.15*). Site ZR2 and 3 also showed some overhanging vegetation and aquatic macrophytes present as cover units. The daily and weekly fluctuation in water level does expose shallower riffle rapid section, but these remain largely uncolonised. The rapid fluctuation in water level prohibits invertebrate colonisation and excludes these areas as feeding grounds for fish.

Table 8.15 Fish Habitat and Cover Ratings Noted for Sites on the Zambezi River Downstream of Kariba Dam

Habitat and velocity type	ZR1	ZR2	ZR3
Dominant Habitat Type:			
Overhanging vegetation	0.00	9.68	11.11
Undercut banks and root wads	0.00	0.00	11.11
Substrate	50.00	32.26	30.56
Aquatic macrophytes	0.00	25.81	13.89
Water column	50.00	32.26	33.33
Velocity Depth Class %:			
Slow-Deep	62.50	25.81	25.00
Slow-Shallow	0.00	12.90	19.44
Fast-Deep	37.50	41.94	36.11
Fast-Shallow	0.00	19.35	19.44
	Dominant type		

KEY FINDINGS – Aquatic Habitats:

Sites on non-perennial systems (Sites D1, 2 and DT3) fell in C ecological categories and reflected Moderately modified conditions. Roads and stream crossings causing secondary impacts related to bed modification were the biggest reasons for the loss in habitat integrity on these non-perennial systems. Sites located on the main stem Zambezi River (ZR1-3) fell into D, C and D categories respectively, and were affected by flow, channel and bed modification induced by the Kariba Dam and the Power station operations.

Diatoms

Sites on the Kariba Dam (KD1) and the Zambezi River downstream of the Dam (KR1 - KR3) were in a Good and Moderate ecological water quality state according to the diatom community (*Table 8.16*). The community at sites reflected the following general conditions for the ecological water quality associated with the Dam and River (*Table 8.17*):

- Alkaliphilious - a diatom community dominated by species with pH preference of >7.
- Fresh-brackish - a community with a preference for Electrical Conductivity of < 500 µs/cm.
- Nitrogen autotrophic sensitive/tolerant - tolerating small to moderate concentrations of organically bound Nitrogen.
- Fairly high oxygen requirements- community requiring >75% Dissolved Oxygen saturation.
- β- Mesoprobous - slightly to moderately polluted conditions.
- Meso-eutrophic - moderate inputs of inorganic nutrients and organic matter.

Forty two diatom species belonging to 15 genera were recorded at sites in the low flow study (*Table 8.18*). The diatom community from the Kariba Dam (KD1) showed some typically lentic species associated with dam and lake environments and spray zones (*Aulacoseira sp* and *Nitzschia supralitorea*). The ecological water quality was Good (*Table 8.16*), showing a dominance of species with a preference for oxygenated, Alkaline waters (*Achnanthidium affine* and *Encyonopsis subminuta*). Dominant species were also indicative of pulses in electrolyte loads, and show a preference for calcium, sulphate and carbonates (*A. affine* and *Nitzschia valdecostata*). Organic inputs at the Dam wall are noted in the %PTV score (22.8%).

The proposed slipway site immediately below the Dam (ZR1) was similar in composition to KD1, however the ecological water quality dropped a class to Moderate. The dominance of *Navicula zanoni* and the diversity of the motile general *Nitzschia* and *Navicula* were the cause for the decline in water quality noted below the Dam wall. These motile species can more easily tolerate disturbance and escape the residual effects of continual disturbance, such as sediment and siltation. Site ZR1 also showed a possible impact related to organic pollutants.

Sites ZR2 and 3 on the Zambezi showed a recovery, with a community indicative of Good water quality. Some impact related to nutrients and eutrophication was noted by the dominance of *Gomphonema minutum* and Fragilaria spp. as agriculture increases in the downstream section of the river. The dominant presence of the pioneer species *Achnanthidium minutissima* at site KR3 may be indicative of a disturbance in flow in this reach.

Table 8.16 Diatom Index Scores for Sites on the Kariba Dam (KD1) and the Zambezi River (KR1-KR3)

Site	No. Species	%PTV	SPI	BDI	Category
KD1	23	22.8	14.1	17.3	**Good**
ZR1	22	19.5	12.1	13.9	**Moderate**
ZR2	15	1	16	15.2	**Good**
ZR3	19	3.8	15.7	16.1	**Good**

Table 8.17 Ecological Descriptors for the Diatom Community at Sites on the Kariba Dam (KD1) and the Zambezi River (KR1-KR3) (Van Dam et al., 2002)

	KD1	ZR1	ZR2	ZR3
pH	Alkaliphilious	Alkaliphilious	Alkaliphilious	Neutral
Salinity	Fresh-Brackish	Fresh-Brackish	Fresh-Brackish	Fresh-Brackish
Nitrogen uptake	Nitrogen Autotrophic Sensitive	Nitrogen Autotrophic Sensitive	Nitrogen Autotrophic Tolerant	Nitrogen Autotrophic Tolerant
Oxygen	Fairly High	Fairly High	Continuously High	Fairly High
Saprobity	β-Mesoprobous	β-Mesoprobous	β-Mesoprobous	β-Mesoprobous
Trophic State	Meso-eutrophic	Meso-eutrophic	Meso-eutrophic	Meso-eutrophic

Table 8.18 Diatom Species Identified for Each Study Site, September 2014

Species	KD	ZR1	ZR2	ZR3	Ecological preferences (Taylor *et al*., 2007; Koekemoer & Taylor, 2012)
Achnanthidium minutissima var. *minutissima*	18	8	8	65	A pioneer species found in well oxygenated, fresh waters.
Achnanthidium affine (Grun) Czarnecki	123	90	43	23	Clean, well oxygenated, oligotrophic, alkaline, calcareous, fresh waters with moderate electrolyte content.
Aulacoseira G.H.K. Thwaites	20	15	0	0	This genera is usually associated with eutrophic lakes and may be benthic or planktonic.
Cocconeis pediculus Ehrenberg	0	0	2	0	
Cocconeis placentula var. *lineata* Van Heurck	0	0	6	15	
Cymbella kolbei var. *kolbei*	1	3	0	0	
Cymbella turgidula var. *turgidula* Grunow 1875	0	4	0	0	
Diploneis elliptica (Kützing) Cleve	1	0	0	0	
Discostella stelligera (Cleve et Grun.) Houk &	19	21	0	0	
Eunotia minor (Kützing) Grunow in Van Heurck	0	0	14	4	
Eolimna minima(Grunow) Lange-Bertalot	0	1	0	1	
Eolimna subminuscula Lange-Bertalot &	2	0	0	0	
Encyonopsis subminuta Krammer & Reichardt	41	0	0	0	Requires oxygen rich environments.
Fragilaria biceps (Kützing) Lange-Bertalot	0	0	45	0	Mesotrophic to eutrophic waters usually found together with with *Fragiliaria ulna*.
Fragilaria capucina Desmazieres var.*capucina*	11	0	15	36	Circumneutral, oligo- to mesotrophic waters with moderate electrolyte content.
Fragilaria capucina var.*vaucheriae* Lange-Bertalot	0	7	0	0	
Fragilaria tenera (W.Smith) Lange-Bertalot	12	20	0	0	
Fragilaria ulna var.*acus* (Kütz.) Lange-Bertalot	8	10	102	0	Found in mesotrophic to eutrophic, alkaline freshwaters.
Gomphonema augur Ehrenberg	0	0	0	2	
Gomphonema clavatum Ehr.	5	5	33	10	A montane species found in oligotrophic waters but able to tolerate a high electrolyte
Gomphonema minutum (Ag.) Agardh f. *minutum*	10	4	123	214	Eutrophic waters but not tolerant to more than moderate levels of pollution.
Navicula cryptotenella Lange-Bertalot	1	0	0	0	
Navicula heimansioides Lange-Bertalot	9	0	0	0	
Navicula microcari Lange-Bertalot	0	0	0	4	
Navicula tridentula Krasske	8	0	0	0	
Navicula zanoni Hustedt	19	109	3	3	Normally associated with alkaline waters.
Nitzschia acicularis (Kützing) W.M.Smith	0	2	0	0	
Nitzschia agnewii Cholnoky	0	0	0	1	
Nitzschia dissipata (Kützing) Grunow	0	1	2	0	
Nitzschia filiformis (W.M.Smith) Van Heurck	0	1	0	0	

Species	KD	ZR1	ZR2	ZR3	Ecological preferences (Taylor *et al.*, 2007; Koekemoer & Taylor, 2012)
Nitzschia gracilis Hantzsch	0	0	0	1	
Nitzschia inconspicua Grunow	0	0	1	0	
Nitzschia intermedia Hantzsch ex Cleve &	0	0	2	1	
Nitzschia lancettula O.Muller	7	19	0	8	
Nitzschia subacicularis Hustedt in A.Schmidt *et*	16	0	0	4	
Nitzschia supralitorea Lange-Bertalot	33	27	1	3	Found in eutrophic waters with moderate to moderately high electrolyte content,
Nitzschia tropica Hustedt	0	0	0	3	
Nitzschia valdecostata Lange-Bertalot et	33	45	0	2	Found in electrolyte rich waters, favouring waters with high concentrations of sulphates
Rhopalodia gibba (Ehr.) O.Muller var.*gibba*	3	5	0	0	
Rhopalodia operculata (Agardh) Hakansson	0	2	0	0	
Sellaphora seminulum (Grunow) D.G. Mann	0	4	0	0	
Sellaphora pseudopupula (Krasske) Lange-	4	0	0	0	
		Dominant species			

<u>KEY FINDINGS - Diatoms</u>:

Sites on the Kariba Dam and the Zambezi River downstream of the Dam were in a Good and Moderate ecological state according to the diatom community. The community at sites reflected slightly alkaline, fresh-brackish, oxygenated waters with Moderate pollution. Site (ZR1), downstream of the Dam wall, showed species with a preference for Sulphate, Calcium and Carbonates, where sites further downstream showed an increase in nutrient tolerant diatoms.

Macroinvertebrates

The macroinvertebrate communities in the study area had a low to moderate diversity comprising of mostly tolerant taxa (*Table 8.19*). A total of 23 families were identified in the reach sampled. Of these families only the Heptageniidae and the Baetidae are considered sensitive to water quality. Many expected flow and water quality sensitive taxa were conspicuously missing from the present assemblage, such as various Trichopterans (Caddisflies), Psephenidae (Water Pennies), Perlidae (Stone Flies), Polymitarcyidae (Pale Burrowers) and Tricorythidae (Stout Crawlers). This trend is consistent with various other studies undertaken downstream of highly regulated systems (Bunn & Arthington, 2002; Jalon *et al*., 1994; Boon, 1993).

The macroinvertebrate assemblage is considered largely modified according to the MIRAI, with reasons for the impact score for the various metric groups given in *Table 8.20*. There was a large loss of families with requirement for various flow conditions, due to the increased baseflow and the loss of seasonality downstream of the Kariba Dam. The change in flow has caused a subsequent change in the level of certain, preferable velocity-depth-habitat biotopes for the macroinvertebrate inhabitation. Sites have lost riffle-run-rapid sequences due to the consistent inundation of these habitat sub-units in the gorge reach, and have thus lost species that have a preference for moderate/fast-shallow waters over substrate. Although all metric show a change from reference, the major driver of change in the system is hydrology, which has a secondary impact on habitat, connectivity and water quality.

Table 8.19 ***Aquatic Macroinvertebrates Sampled during the September 2014 Survey with Relevant Abundance and Sensitivity Scores according to Dickens & Graham (2001)***

Taxon	Sensitivity Score	ZR1	ZR2	ZR3
Oligochaeta	**1**	A	A	A
Potamonautidae*	**3**		A	
Atyidae	**8**		A	B
Baetidae 2 sp.	**6**		B	
Baetidae > 2 sp.	**12**			B
Caenidae	**6**		A	
Heptageniidae	**13**		A	
Leptophlebiidae	**9**		A	
Coenagrionidae	**4**		A	B
Corixidae*	**3**		B	

Taxon	Sensitivity Score	ZR1	ZR2	ZR3
Gerridae*	**5**		B	
Veliidae*	**5**		B	
Hydropsychidae 1 sp.	**3**	C		
Hydropsychidae 2 sp.	**6**		A	
Hydroptilidae	**6**			A
Gyrinidae*	**5**		B	A
Chironomidae	**2**	A	B	A
Simuliidae	**5**			A
Lymnaeidae*	**3**	A	1	B
Physidae*	**3**		A	
Planorbinae*	**3**		A	B
Thiaridae	**3**	A	B	B
Corbiculidae	**5**	A	B	B
Score		**18**	**93**	**51**
No. of Taxa		**6**	**19**	**12**
ASPT		**3.00**	**4.89**	**4.25**

	Sensitive taxa
	Moderately tolerant to pollution
*	Air breathing
1	1 individual
A	2-10 individuals
B	11-100 individuals
C	101-1000 individuals

Table 8.20 *Aquatic Macroinvertebrates Integrity as Ascertained by the MIRAI Index for the Habitat Unit/Reach on the Zambezi River Downstream of Kariba Dam Wall*

Invertebrate Metric Group	Calculated Score (%)	Rank	%Weight	Reason for MIRAI output
Flow Modification	46.1	1	100	Absence of Gomphidae, Leptoceridae, Libellulidae
Habitat	47.5	2	80	Absence of Trichopterans, Polymitarcyidae and Tricorythidae
Water Quality	59.4	3	50	Absence of Psephenidae, Perlidae
Connectivity & Seasonality	40.0	4	40	Paleomonidae and Unionida absent from reach
Invertebrate EC			**48.1%**	
Invertebrate EC Category			D	

KEY FINDINGS - Macroinvertebrates:

The macroinvertebrate assemblage is considered Largely modified due to a knock-on effect from flow regulation from the dam on habitat, connectivity and water quality. A decrease in diversity and a large loss of macroinvertebrate families with requirements for various flow conditions were noted. Although all metrics show a change from reference conditions, the major driver of change in the system is hydrology, which has a subsequent impact on habitat, connectivity and water quality.

Fish

Fish Community - Expected and Sampled

Fish assessments, prior to the construction of Kariba Dam yielded 28 fish species, whilst later assessments within and upstream of the Dam yielded 42 species (WCD, 2000). It is likely that the low initial species count may be attributed to under sampling. More recent studies reports 45 species for the middle Zambezi River (Bills and Marshall, 2004), while the IUCN Bio Browser lists 48 possible species. The expected list provided in this report is a combination of the existing information and comprises of approximately 13 families, 28 genera and 51 indigenous species, while 22 species have been sampled in the present survey, representing 9 families and 15 genera (*Table 8.21*; *Table 8.22*).

The majority of expected species carry an IUCN conservation status of Least Concern (LC), while two potentially occurring species (*Oreochromis mortimeri* and *O. macrochir*) are Critically Endangered (CR) and Vulnerable (V), respectively. The conservation status of both species, *O. mortimeri* and *O. macrochir,* are attributed to the introduction of the exotic *Oreochromis niloticus*. *Oreochromis mortimeri* is more affected by *O. niloticus* due to hybridisation, while *O. macrochir* is affected by competition and displacement by *O. niloticus*. It should be noted that *O. macrochir* itself has been introduced to Kariba Dam and the middle Zambezi from the upper reaches. The presence of *O. mortimeri* remains to be confirmed following the September 2014 assessment, although the proposed activities are unlikely to aggravate the existing conservation status of this fish.

Chiloglanis neumanni have been sampled downstream of the Dam during the September 2014 assessment, albeit in low numbers and at a single location. This species is listed as Data Deficient (DD) by the IUCN.

The reference fish community for the middle Zambezi River differs from the upper and lower reaches, due to the historical evolution of the River, differences in the nature of the system and the presence of large natural migration boundaries, like Victoria Falls. The reference fish community generally consists of widespread and common species, although several are limited in distribution to the Zambezi and adjacent rivers (*Opsaridium zambezense, Synodontis zambezensis* and *Pharyngochromis acuticeps*) and the reach is dominated by Cichlids, Cyprinids, and Mormyrids. Several larger species like *Heterobranchus longifilis, Malapterurus shirensis, Distichodus mossambicus* and *D. schenga* are found in the Zambezi system only below Victoria Falls, whereas the creation of extensive new limnetic habitats has changed the composition of the fish populations (Timberlake, 1997; Davies, *et al*., 1986). A post-Dam fish community reflects a dominance of Cichlids, Mochokids and Alestids. Rheophilic fishes such as *Amphilius uranoscopus*, *Zaireichthys rotundiceps*, *Opsaridium zambezense* and *Labeobarbus marequensis* have disappeared from the reach of River affected by Kariba Dam. While some, more tolerant rheophilic species such as *Chiloglanis neumanni* also reflect a much lower occurrence under current conditions. The frequency of occurrence for fishes with specific migration requirements (most of the *Labeo, Barbus* and *Anguilla* species) have also been negatively affected. It is likely that the absence of the smaller *Barbus* species may be attributed to changes in the flow regime and the alteration of instream habitat.

Table 8.21 Summary Table Showing the Number of Expected and Sampled Fish Families, Genera and Species for the Middle Zambezi

	Expected	Sampled
Families	13	9
Genera	29	15
Species	53	22

Table 8.22 Expected and Sampled Fish Showing IUCN Conservation Status

Family	*Genus Species*	*Common Name*	Local Name	IUCN	Site
Anguilliformes					
Anguillidae	*Anguilla bengalensis ssp. Labiata*	Indian Mottled Eel	Solomon Fish	NT	
Anguillidae	*Anguilla marmorata*	Marbled Eel	Solomon Fish	LC	
Anguillidae	*Anguilla mossambicus*	Longfin Eel	Solomon Fish	LC	
Characiformes					
Alestidae	*Brycinus lateralis*	Stripped Robber	Chenga	LC	ZR3
Alestidae	*Bycinus imberi*	Imberi	Chenga	LC	ZR1,2,3
Alestidae	*Hydrocynus vittatus*	Tigerfish	Tiger Fish	LC	ZR2,3
Alestidae	*Micralestes acutidens*	Sharptooth tetra	Chenga	LC	ZR2,3
Distichodontidae	*Distichodus mossambicus*	Nkupe	Nkupe	LC	
Distichodontidae	*Distichodus schenga*	Chessa	Chesa	LC	ZR1,2,3
Cypriniformes					
Cyprinidae	*Barbus annectance*	Broadstripe Barb	- Mimbulwe	LC	
Cyprinidae	*Barbus afrovernayi*	Spottail Barb	- Mimbulwe	LC	
Cyprinidae	*Barbus fasciolatus*	African banded barb	- Mimbulwe	LC	
Cyprinidae	*Barbus paludinosis*	Straightfin barb	Mimbulwe	LC	
Cyprinidae	*Barbus poechii*	Dashtail barb	- Mimbulwe	LC	
Cyprinidae	*Barbus radiatus*	Redeye Barb	- Mimbulwe	LC	
Cyprinidae	*Barbus trimaculatus*	Threespot barb	- Mimbulwe	LC	
Cyprinidae	*Barbus unitaeniatus*	Slender barb	- Mimbulwe	LC	ZR3
Cyprinidae	*Cyprinus carpio*	Wild Common Carp	-	Exotic	
Cyprinidae	*Labeo altivelis*	Sailfin mudsucker	- Mpumbu	LC	
Cyprinidae	*Labeo congoro*	Purple Labeo	Mpumbu	LC	ZR2
Cyprinidae	*Labeo cylindricus*	Redeyed labeo	Ningu	LC	ZR1,2
Cyprinidae	*Labeo molybdinus*	Leaden Labeo	- Ningu	LC	
Cyprinidae	*Labeobarbus marequensis*	Lowveld Largescale Yellowfish	Chitumbwa	LC	
Cyprinidae	*Opsaridium zambezense*	Dwarf Sanjika	N-angazambia	LC	

Family	*Genus Species*	*Common Name*	Local Name	IUCN	Site
Cyprinodontiformes					
Poeciliidae	*Aplocheilichthys johnstoni*	Johnston's Topminnow	Mimburwe	LC	ZR2
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	-	Exotic	
Lepidosireniformes					
Protopteridae	*Protopterus annectens*	African Lungfish	Inkomo	LC	
Protopteridae	*Protopterus annectens ssp. brieni*	African Lungfish	Inkomo	LC	
Osteoglossiformes					
Mormyridae	*Cyphomyrus discorhynchus*	Zambezi Parrotfish	Nyanzi	LC	ZR1,2,3
Mormyridae	*Marcusenius altisambesi*	Bulldog	Chise	LC	
Mormyridae	*Marcusenius macrolepidotus*	Bulldog	Chise	LC	
Mormyridae	*Mormyrops anguilloides*	Cornish jack	Lombo-lombo	LC	ZR2,3
Mormyridae	*Mormyrus longirostris*	Eastern Bottlenose	Botoro Fish	LC	
Perciformes					
Cichlidae	*Oreochromis macrochir*	Greenhead Tilapia	White Bream	V	
Cichlidae	*Oreochromis mortimeri*	Kariba Tilapia	White Bream	CR	
Cichlidae	*Oreochromis niloticus*	Nile Tilapia	White Bream	Exotic	ZR3
Cichlidae	*Pharyngochromis acuticeps*	Zambezi River Bream	Lufindu	LC	ZR1,2,3
Cichlidae	*Pseudocrenilabrus philander ssp. Philander*	Southern Mouthbrooder	Lufindu	LC	ZR1
Cichlidae	*Sargochromis carlottae*	Rainbow Bream	-	LC	
Cichlidae	*Sargochromis codringtonii*	Green Bream	-	LC	
Cichlidae	*Sargochromis giardi*	Pink Bream	-	LC	
Cichlidae	*Serranochromis macrocephalus*	Purpleface largemouth	Mbiriya	LC	
Cichlidae	*Serranochromis Robustus*	Yellow-belly Bream	Makovo	LC	
Cichlidae	*Tilapia rendalli*	Northern Redbreast Tilapia	Red Bream	LC	ZR1,2,3
Cichlidae	*Tilapia sparrmanii*	Sparrman's Bream	-	LC	ZR2,3
Siluriformes					
Amphiliidae	*Zaireichthys rotundiceps*	Spotted Sand Catlet	-	LC	
Clariidae	*Clarias gariepinus*	Sharptooth Catfish	Mulamba	LC	
Clariidae	*Heterobranchus longifilis*	Vundu	Vunda	LC	
Malapteruridae	*Malapterurus shirensis*	Electric Catfish	Ntetenezi	LC	ZR1
Mochokidae	*Chiloglanis emarginatus*	Phongolo Suckermouth	Mbowa	LC	
Mochokidae	*Chiloglanis neumanni*	Neumann's suckermouth	Mbowa	DD	ZR2
Mochokidae	*Synodontis zambezensis*	Brown Squeaker	Choko-choko	LC	ZR1,2,3

Family	*Genus Species*	*Common Name*	Local Name	IUCN	Site
Mochokidae	*Synodontis nebulosus*	Cloudy Squeaker	Choko-choko	LC	ZR1
Schilbeidae	*Schilbe intermedius*	Silver Butter Catfish	Silver Fish/ Shlitungu	LC	ZR3

	Sampled
	Exotic
	Introduced

Fish Community Assemblage Integrity

The community integrity assessment did not differentiate between the three different sites assessed, instead the stream was considered as a reach, and the occurrence of species at each site was used to infer the frequency of occurrence of each species in the river reach. Spatial variations were however noted between sites assessed and are discussed in a separate section below. The present fish community shows a Moderate to Largely altered state in comparison to reference fish assemblages, and fell into a C/D ecological category (*Table 8.23*). A comparison between the habitat preferences and environmental tolerances of the expected and the sampled community highlighted the following (*Table 8.23*; *Figure 8.20* to *Figure 8.24*):

- Flow modification contributed the most towards digression from reference condition.

- Secondary factors (related to flow alteration) such as a loss in preferred velocity and depth classes also contributed notably towards the altered state of the present fish community.

- The reference fish community were dominated by species with a preference for slow-deep flowing water associated with overhanging vegetation and substrate. Less than half of the expected fish with the above mentioned preferences have been sampled during the September 2014 assessment (*Figure 8.20*; *Figure 8.21*).

- The sampled fish community is proportionally more represented by fish with a tolerance to no-flow conditions, compared to the reference assemblage, which is dominated by moderately tolerant species (*Figure 8.22*).

- The proportional distribution of fish with different water quality tolerances in the reference community is comparable to the sampled community, although in much lower abundances (*Figure 8.23*). This suggests that water quality is probably not a notable driver of change in fish assemblages. As a general rule of thumb, fish that are sensitive to change in flow are also sensitive to alteration in water quality.

- Most of the fish sampled reflected an intra-reach migration requirement. Although not all fish with this requirement are equally affected by migration barriers. A large decline in fish with a specific migration requirement has been noted (*Figure 8.24*).

- Further contributing to deviation from reference fish assemblages are the alien and exotic species. Of the expected alien fish only one has been sampled, *O. niloticus*. This fish is probably still expanding its range and is likely impacting on other indigenous niche occupiers (*Table 8.21*).

Table 8.23 Fish Assemblage Integrity Score and Category as Indicated by the Fish Response Assessment Index (The Table also indicates the extent of alteration in drivers as inferred from preference and tolerance variation between the expected and sampled fish communities)

	Calculated Score (%)	Overall EC	Description
Drivers		C/D	A Moderate to Large loss in fish community assemblages compared to reference conditions.
Velocity Depth	57.6		
Cover	36.3		
Flow modification	62.0		
Water Quality	19.0		
FRAI	57.6		

Figure 8.20 Bar Graph Showing the Number of Fish with Specific Velocity-depth Preferences Expected and Sampled

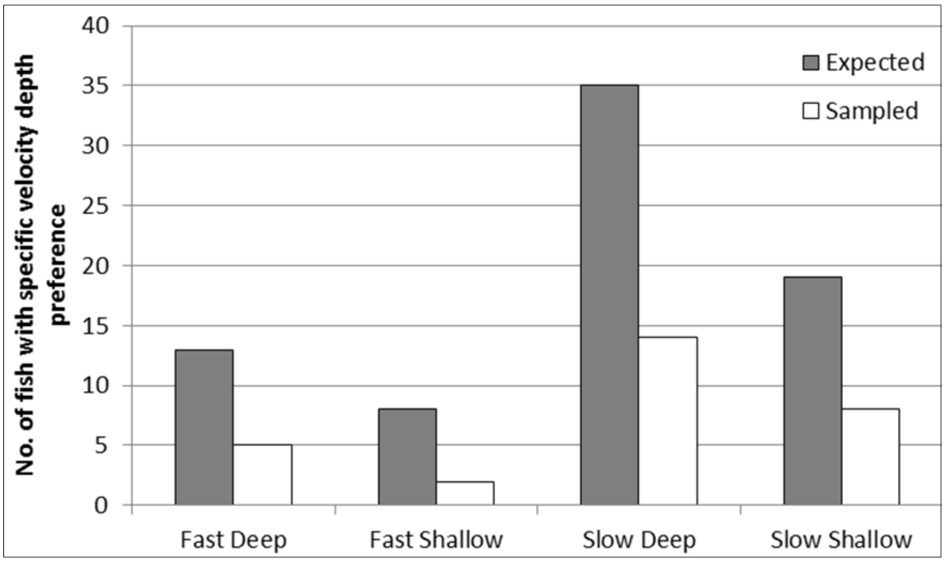


Figure 8.21 Bar Graph Showing the Number of Fish with Specific Cover Preferences for the Expected and Sampled Fish Community

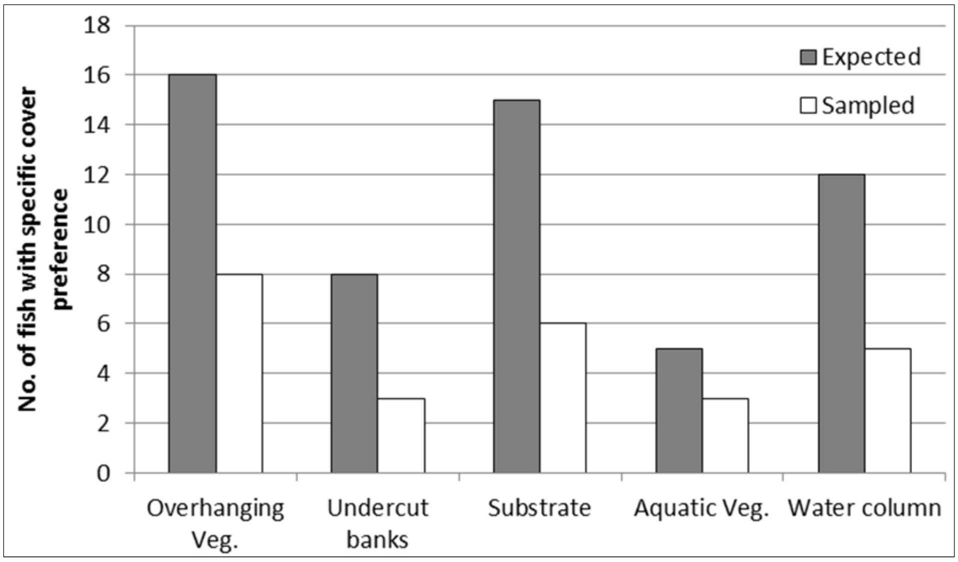


Figure 8.22 Bar Graph Showing the Number of Fish of the Expected and Sampled Community, with Different Tolerances to No Flow Conditions

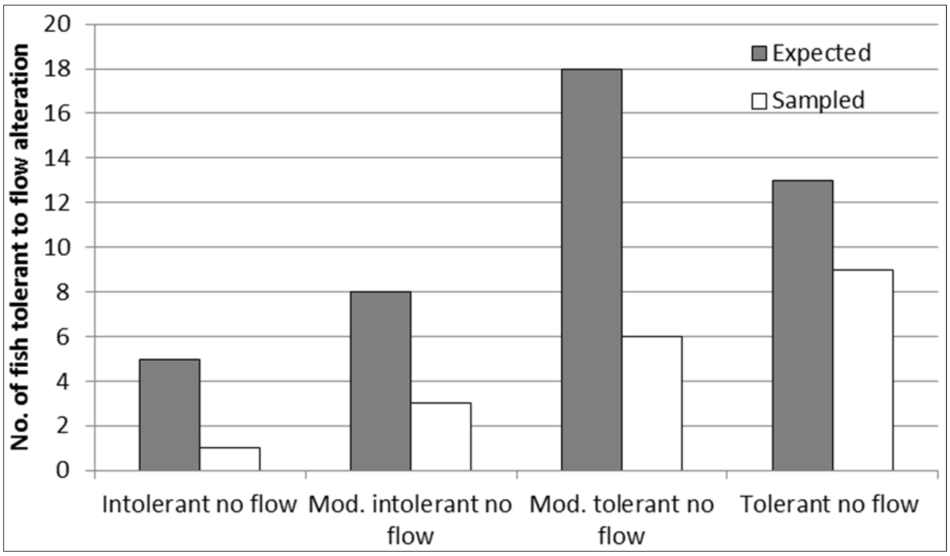


Figure 8.23 Bar Graph Showing the Number of Fish of the Expected and Sampled Community, with Different Tolerances to Changes in Water Quality

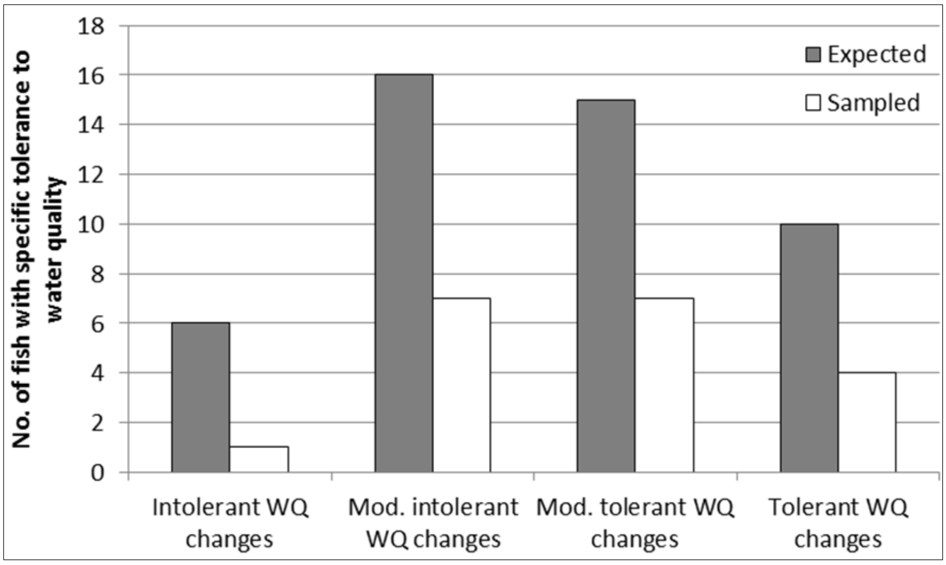
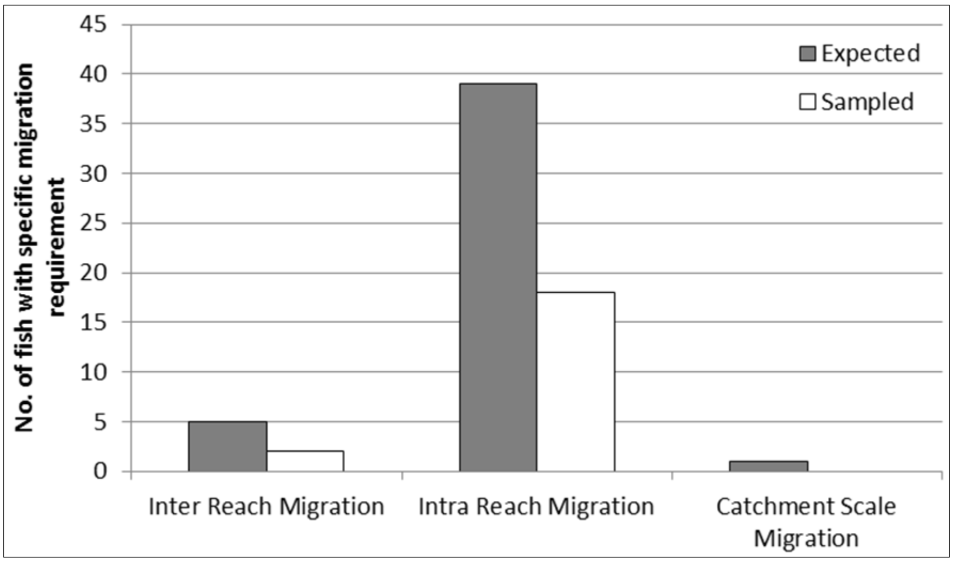


Figure 8.24 Bar Graph Showing the Number of Fish with Specific Migration Requirements for the Expected and Sampled Fish Community



<u>*Spatial Variation in Fish Communities*</u>

Site ZR1 yielded the lowest fish abundances, number of species and overall diversity score (*Figure 8.25* and *Figure 8.26*). Concurrently, site ZR2 reflected the highest number of species followed by site ZR3, the latter showed a better evenness distribution and subsequently measured a higher diversity. The spatial variation in evenness distribution, between the three sites, is represented in *Figure 8.27*. Less than 20 percent of the total fish abundance for site ZR3 can be allocated to a single species. Conversely, nearly 50 percent of the fish abundances for site ZR1 are represented by a single species. Impacted sites are typically characterised by higher abundances of more tolerant species and a displacement or loss of niche occupiers and more sensitive species.

In summary, it can be said that baseline fish assemblages reflected a Moderate to Large change from reference assemblages. The most notable cause for this change is alteration in the natural flow regime and a change in velocity-depth constituents from reference conditions. The assessment further ascertained measurable performance metrics (existing species composition) for future monitoring purposes at three sites downstream of the proposed activities. The results of the fish assessment will be augmented with another high flow assessment.

Figure 8.25 Line Graph Showing Overall Total Abundances and Species Richness Obtained for Respective Sites

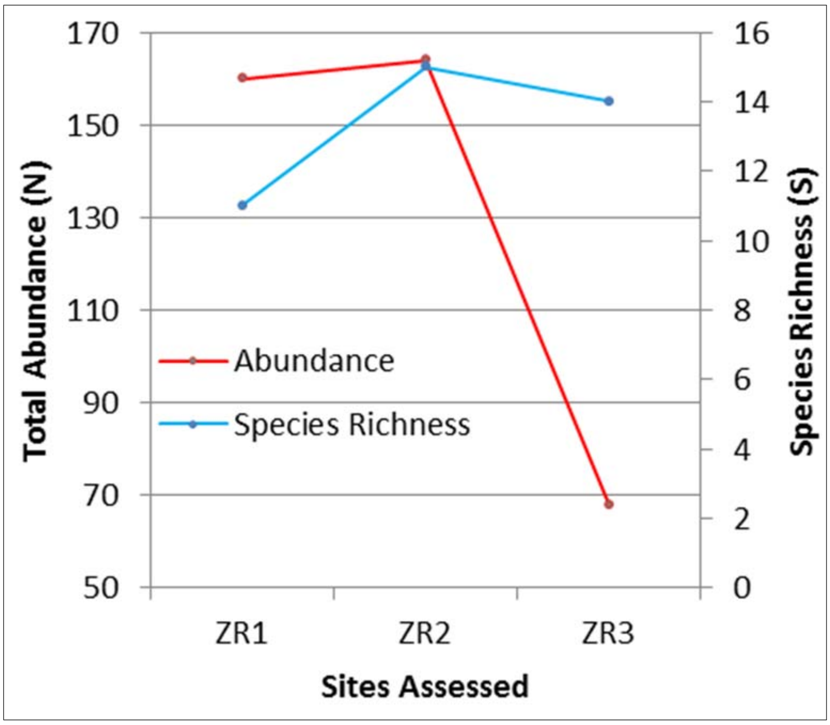


Figure 8.26 Line Graph Showing Spatial Variation in Fish Diversity and Evenness Distribution for Different Sites Assessed

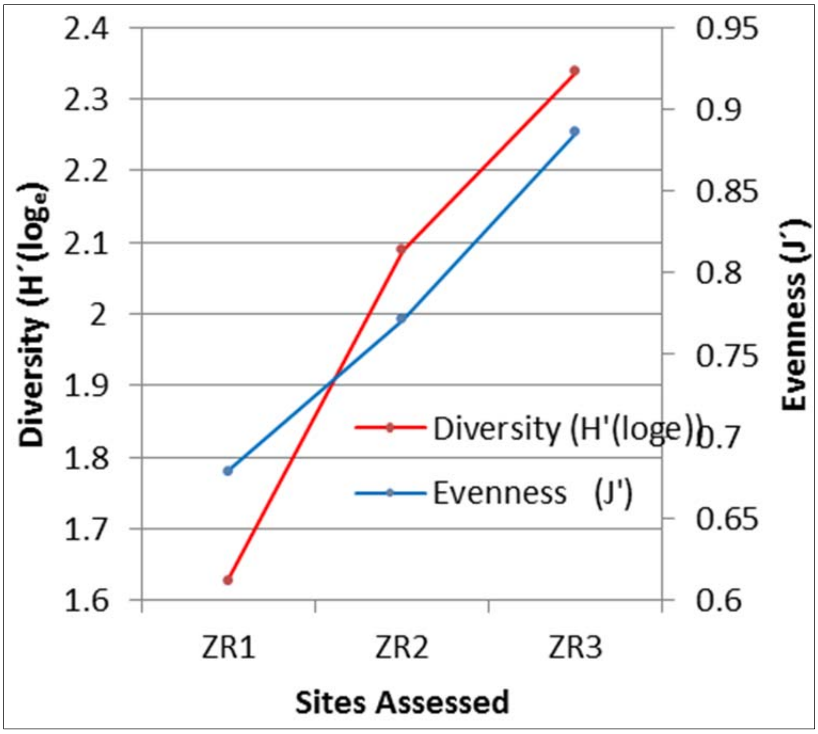
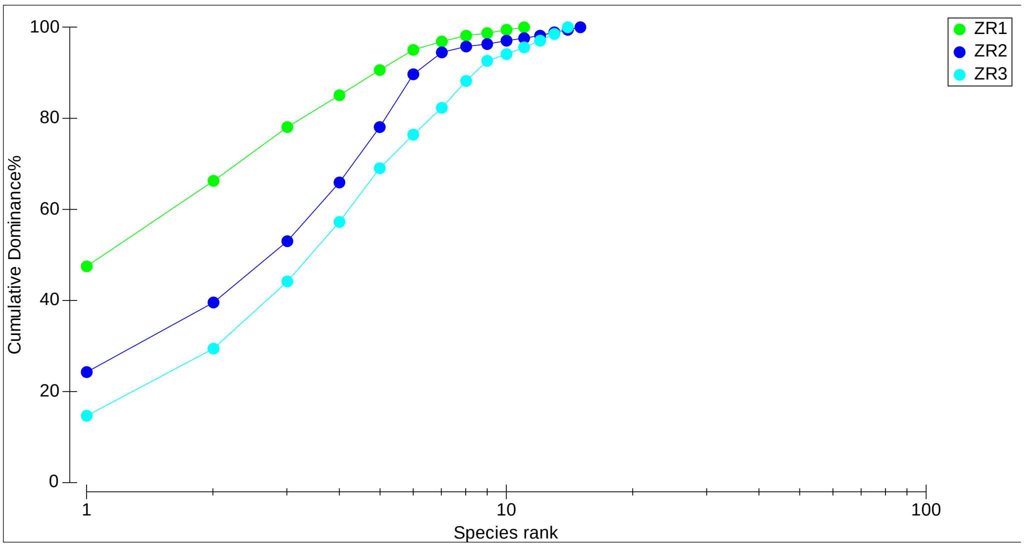


Figure 8.27 Cumulative Dominance Plot for Fish Assemblages Linked to the Sites Assessed



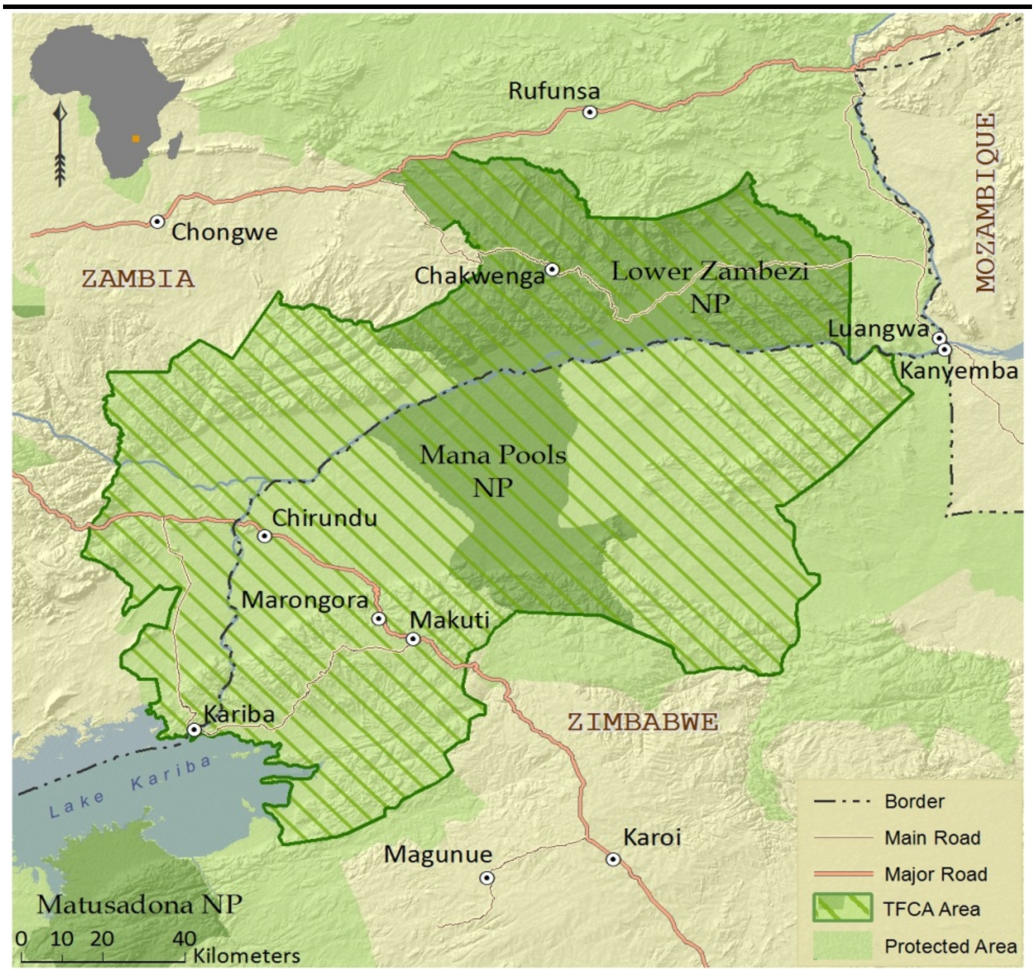
KEY FINDINGS - Fish:

Baseline fish assemblages reflected a Moderate to Large variation from reference assemblages. The most notable cause for this change is alteration in the natural flow regime and a change in velocity depth constituents from the reference conditions. A longitudinal improvement in fish assemblage was noted.

8.2.6 *Protected Areas*

The Project is located within the Lower Zambezi Transfrontier Conservation Area (LZTFCA) (see *Figure 8.28*). In Zambia this Transfrontier Conservation Area (TFCA) includes the Open Area around Siavonga down to Chirundu, Chiawa Game Management Area and Lower Zambezi National Park. In Zimbabwe the TFCA includes the Charara, Urungwe and Rifa Safari Areas between Kariba and Chirundu, Mana Pools National Park, Sapi and Chewore Safari Areas down to Kanyemba.

Figure 8.28 Lower Zambezi Transfrontier Conservation Area



Source: Peace Parks Foundation, 2014.
(http://www.peaceparks.org/tfca.php?pid=19&mid=1019. Accessed 11 November 2014)

Mana Pools National Park, Sapi and Chewore are a designated United Nations Organization for Education, Science and Culture (UNESCO) World Heritage Sites based on the area's wildlife populations and outstanding beauty (http://whc.unesco.org/pg.cfm?cid=31&id_site=302). The Zimbabwean side of the LZTFCA is also a regionally Important Bird Area (IBA) (Childes & Mundy, 2001).

While the Project is located in the LZTFCA, the Project's Direct Area of Influence only extends 5km from the Kariba Dam wall into the LZTFCA, and the Indirect Area of Influence extends 10km into the LZTFCA.

The Open Area from Siavonga to Chirundu and further down to Chiawa is largely under agriculture. The Zambian Wildlife Authority (ZAWA) manages the wildlife in Chiawa and Lower Zambezi, whilst on the Zimbabwean side all the land is protected under the Parks and Wildlife Management Authority. The wildlife areas on both sides of the river are popular tourist destinations.

8.3 SOCIAL ENVIRONMENT

This *Section* of the report provides a description of the social environment (which includes economic, health, and cultural heritage aspects) in the Project Affected Areas (PAA). It provides a comprehensive description of the characteristics of the Social Study Area (SSA) and draws on primary data specifically collected for this purpose as well as secondary data sources.

Please refer to *Annex D* for a description of definitions commonly used in this *Section* and approach and methodology for social baseline data collection.

8.3.1 Social Project Area of Influence

The Area of Influence (AoI) can be defined as an area likely to be impacted by the Project activities during execution of rehabilitation works. The effects of these can be positive or negative, short or long term or permanent, as well as direct, induced and in-direct.

The AoI is described as:

- The **primary Project site(s)** and related facilities that the Project Proponent develops or controls (such as temporary secondary roads, disposal areas, and construction camps) and the additional areas in which aspects of the environment could conceivably experience significant impacts.

- **Associated facilities** that are not developed and funded as part of the Project but are essential for the Project and without which the Project cannot proceed, and the associated additional areas in which aspects of the environment could conceivably experience significant impacts.

- **Areas potentially affected by cumulative impacts** resulting from other developments known at the time of the impact assessment, further planned phases of the Project or any other existing circumstances.

- Areas potentially affected by impacts from **predictable (but unplanned) developments** as a result of the Project (i.e. induced activities), occurring at a later stage or at a different location.

The social AoI is shown in *Chapter 2*.

8.3.2 *Governance and Administrative Structures of Zambia and Zimbabwe*

Both Zimbabwe and Zambia have a dual governance system based on elected political governance structures and traditional leadership structures. These systems are recognised as complementary but have different responsibilities.

Administrative Structures in Zimbabwe

Zimbabwe is divided into ten administrative Provinces; eight of which are predominantly rural and two predominantly urban. The urban Provinces are Bulawayo and Harare, which were established in 2005. Each Province is divided into Districts, which are further divided into Wards or Municipalities. Currently, there are 59 Districts which consist of 1,200 Wards. Local government in Zimbabwe is governed by the Ministry of Local Government, Rural and Urban Development (MLGRUD). Key roles and responsibilities of local government legislation are indicated in *Table 8.24* below.

Table 8.24 ***Local Government Legislation: Roles and Responsibilities***

Legislation	Roles and responsibilities
• Rural District Councils Act (1996); • Urban Councils Act (1996); • Regional Town and Country Planning Act (1976); • Traditional Leaders Act (2000); and • Provincial Councils and Administration Act (1985).	• Plan and implement local development; • Provision and management of basic services, including health, education, refuse removal, water, and sanitation; • Provision and maintenance of roads; • Provision of housing and serviced stands; and • Provision of social welfare services.

Source: Jaap de Visser, et al, 2010. Local Government Reform in Zimbabwe: A Policy.

<u>*Provincial Government*</u>

Each Province is administered by a presidentially appointed Ministry of State for Provincial Affairs who is supported by the Provincial Administrator and several ministries. The Ministry of State for Provincial Affair is the head of the Provincial Councils (PCs) whose members include:

- Mayors and one councillor from each municipality and city council in that province;
- Chairperson and one councillor from Town Councils, Local Boards and Rural District Councils in that province; and
- Representatives from the Provincial Assembly of Chiefs.

The PCs' main functions are co-ordination and development of provincial matters. They are supported by the Provincial Development Council (PDC). The PDC is comprised of –

- Ministry of State for Provincial Affair as Chairperson;

- Heads of line ministries in the Province including the security Ministries;
- District administrators in the Province;
- Town clerks, town secretaries and local board secretaries in the Province;
- Chief executive officers of Rural Development Councils (RDCs);
- Captains of commerce and industries in the province;
- Heads of parastatals in the province; and
- Heads of civil society organisations in the province.

Provinces also have Councils (which act as urban and rural local authorities). The Councils are divided into Wards (and villages in rural areas or neighbourhoods in urban areas). Each ward is represented by a Councillor elected by a simple majority. Ward boundaries in rural areas do not always coincide with the mosaic of hereditary chieftainships, which are subdivided into areas governed by headmen and village heads. The local government structures are discussed further below.

Local Government -Rural and Urban District Council

Local government comprises of Rural and Urban District Councils. In 2010, Zimbabwe had 60 rural and 31 urban, local authorities. Council areas are divided into wards, each represented by an elected councillor. Local authorities function by, and are structured on, a committee system. These are set up in accordance to Sections 4 to 14 of the Rural District Councils Act and the Urban Councils Act of 1996.

Urban District Council (UC)

The UC comprise of cities, municipalities, town councils, and local boards. Urban Councils are hierarchically organised, based mainly on their size and functions. At the highest level, there are cities/town council (seven) and at the lowest level, local boards (four). Town Councils and Local Boards have Chairpersons and Secretaries as heads of their policy making bodies and management, respectively. Whereas, Municipalities and City Councils have Mayors and Town Clerks and own land within their boundaries, Local Boards and Town Councils do not have that power. Functions of UCs range from the core business of councils which is service provision, to issues to do with allowances, mementoes, and orchestras and bands. To better conduct their responsibilities, councils have standing committees. Typically, UCs have the following standing committees:

- Finance Committee – responsible for regulating financial affairs;
- Health and Housing Committee - responsible for health and housing matters; and
- Environmental Management Committee - responsible for environmental matters.

Rural District Council (RDC)

RDCs are established in terms of section 8 of the RDCs Act [Chapter 29:13]. RDC boundaries coincide with boundaries of administrative districts, minus UC land and land under national parks. The Act also provide for the appointment of committees of councils; which often consist of:

- The ward councillor representing wards that fall wholly or partly within the urban land;

- Members of Village Development Committees or Neighbourhood Development Committees in the area; and

- No more than two co–opted members per ward in the area.

Each district is administered by the Rural District Council, which comprises of ward councillors, a District Administrator, and a representative of a traditional leader (chief) who is appointed under customary law. Other government functions at district level are administered by district offices of national government departments.

The Act also provides for the appointment of a Town Board for each town. The board is composed of councillors for the town wards and such number of persons, but not exceeding one person fewer than the number of ward councillors. The Town Board has no power to impose levies, special rates, rents or charges. Other committees of the RDCs include the Roads Committee, the Ward Development Committee and the Rural District Development Committee (RDDC). The RDDC consist of:

- The District Administrator as chairman;
- The chairperson of every Council Committee;
- The Chief Executive Officer of council and other senior officials of Council;
- Senior officers of security ministries;
- District heads of ministries; and
- Other interest groups.

Ward Council

In rural local authorities, policy making is done at village assemblies, ward assemblies, and the full Council; in ascending order. The Ward assembly is made up of all headmen, village heads, and the Councillor for the Ward. The Ward assembly is chaired by a headman, and its technical work is undertaken by a Ward Development Committee, which comprises of an elected Ward Councillor (as the chairperson), Headmen (traditional leaders subordinate to the chiefs), and Village Development Committee representatives.

Wards are further divided into villages. Each village has a Village Development Committee and a traditional leader subordinate to the Headman. The committee is chaired by the village head. The assemblies are

chaired by village heads, and are based on the principle of universal participation (in other words by all villagers above 18 years of age). Technical matters of the assembly are handled by a committee that draws on technical input of people from within the village.
Traditional Leadership Structure

The appointment of Chiefs, Headmen and Village Heads is provided for in the Traditional Leaders Act (1998). Chiefs are appointed (and dismissed) by the President to preside over communities inhabiting communal land and resettlement areas. The appointment takes into consideration the prevailing customary principles of succession, if applicable to the community over which the Chief is to preside; and the administrative needs of the communities in the area concerned in the interests of good governance. A Chief qualifies for the payment of a salary, allowances, gratuities and a pension. The Chief's roles include performing of functions associated with the office of a chief as community leader, as well as the maintenance and promotion of community cultural values. Functions further include:

- Promoting and upholding cultural values among members of the community under his jurisdiction, particularly the preservation of the extended family and the promotion of traditional family life.

- Supervising headmen and village heads in the performance of their duties; and discharging any functions conferred upon him in terms of the Customary Law and Local Courts Act.

- Overseeing the collection of levies, taxes, rates and charges payable in terms of the Rural District Councils Act by village heads.

- Ensuring that Communal Land is allocated in accordance with the Communal Land Act.

- Ensuring that the land and its natural resources are used and exploited within legal boundaries.

- Protection of public infrastructure and services.

- Adjudicating in and resolving disputes related to land in his area.

- Maintaining up-to-date registers with all villages' names, their inhabitants and copies of land certificates.

Headmen and Village Heads

The Chief nominates a person to serve as Headman and the Headman is appointed by the Minister [(1)]. A headman qualifies for a salary and

(1) Minister" means the Minister of Local Government and National Housing or any other Minister to whom the President may, from time to time, assign the administration of this Act

allowances. The Village Heads are nominated by the Headmen, and appointed by the Secretary (1) of the Minister of Local Government, along with the written approval of the relevant area Chief. Village Heads assist Headmen in their duties and they qualify for payment from the rural district council. The duties of Headmen and Village Heads are summarised below in *Table 8.25*.

Table 8.25 Duties of the Headmen and Village Heads

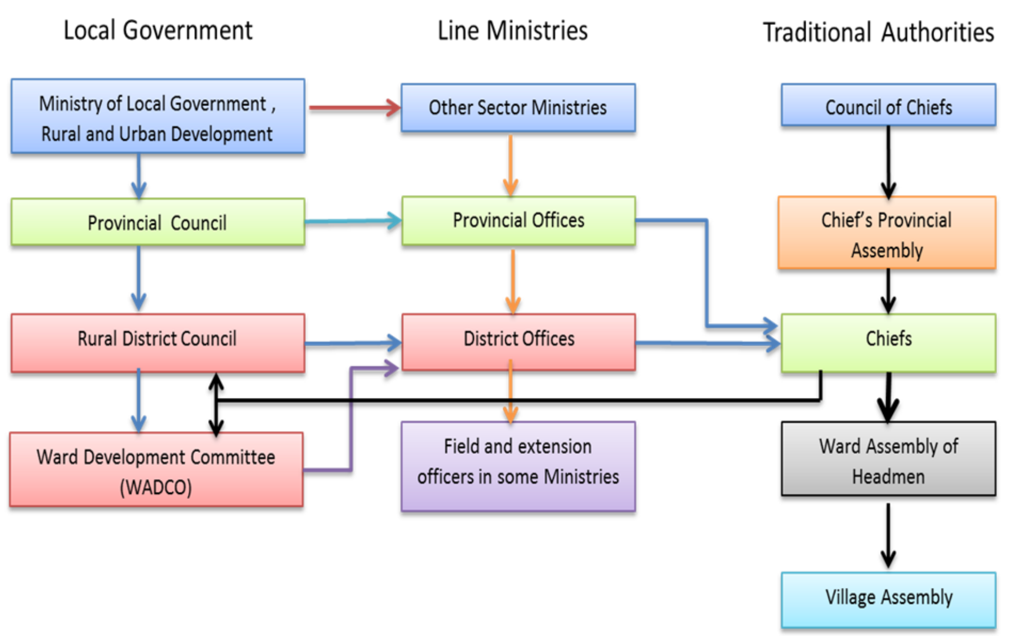
Headmen	Village Heads
• To report to the police any crime or offence in his area and any actual or threatened public unrest likely to disturb the public peace. • To report all criminal acts, acts of misconduct and violations of customs and traditions to the chief and any other appropriate authority. • To preside over a Ward Assembly when elected as chairman. • To oversee the disposal of settlement rights in Communal Land and the admission of new settlers in the area under him. • To keep an up-to-date register of the villages and Village Heads under him and to keep the Chief and the Rural District Council informed of any changes to the register. • To mediate in local disputes involving customary law on matters such as *lobular*, elopement, and others.	• To consider requests for settlement by new settlers into the village and, in consultation with the Village Assembly, to make recommendations on the matter to the Ward Assembly. • To settle disputes involving customary law and traditions, and to refer these matters for settlement by the headman. • To preside over the Village Assembly. • To produce, in consultation with the Village Assembly, Village Development Plans for his area and to submit them to the Ward Assembly. • To preside over the Village Development Committee. • To collect levies, taxes and other charges payable in terms of the Rural District Councils Act. • To maintain an up-to-date register of names of the inhabitants of his village, and their settlement permits.

Source: Jaap de Visser, et al, 2010. Local Government Reform in Zimbabwe: A Policy.

Figure 8.29 below illustrates the linkages between the political and traditional governance structures in Zimbabwe.

(1) Secretary" means the Secretary of the Ministry for which the Minister is responsible

Figure 8.29 Links between Political and Traditional Governance Structures



Administrative Structures in Zambia

At national level, governance structures comprise of elected members of parliament. Government functions are performed by the Cabinet of the ruling party through various ministries. These ministries are headed by a Minister at national level and representatives at provincial and district levels.

Provincial Government

Each of the ten Provinces is headed by a Provincial Minister who is appointed by the President. The planning and implementation of provincial social and economic development programmes is done by Provincial Development Coordinating Committees (PDCC). District Development Coordinating Committees (DDCC) was established by the Government in 1995, to co-ordinate development activities at a District level.

Local Government – District Councils

The local governance system is governed by the Local Government Act of 1991 (Cap 281 of the Laws of Zambia), which gives central government supervisory powers over local government and local authorities. The local government structure is a single tier comprising of City, Municipal or District Councils. In general, city councils are located in the urban districts which have higher population numbers and diverse economic activities while the municipal councils cover the peri-urban regions. District councils are located in the rural districts, which have smaller populations that rely on agriculture. Hence, District Councils generate less local tax revenue than City Councils.

Legally, all District Councils are responsible for the provision of services as laid down in the Local Government Act. The Act also stipulates that Local Councils consist of members of Parliament in the District, two Chiefs' Representatives (who are appointed by the consortium of local Chiefs within the District) and all the elected Councillors within the District. Districts are further divided into Wards represented by elected Ward Councillors.

The District elections take place every five years to align with the national elections. The District Council is headed by a Council Chairperson. The Council is responsible for the formulation of all local developmental policies in the District. Furthermore, the Council is required to work in three committees responsible for various service provisions. These committees are:

- The finance, commerce and general purposes committee;
- The plans, works, water and sanitation committee; and
- The staff establishment and social committee.

The District Council employs personnel that manage the affairs of the District, which personnel make up the Administrative Council. The Administrative Council is responsible for executing District Council duties and decisions. The person leading the Administrative Council is the Council Secretary who is aided by the Deputy Secretary (Administration), Treasurer (Finance), Director of Works (Engineering) and District Planning Officer (Planning).

The DDCC is an advisory committee to the District Council, comprising non-governmental organisations (NGOs), Private Sector and various sector ministerial departments that perform specified Government functions. The main function of the DDCCs is to co-ordinate developmental activities in the District and to formulate and recommend development programmes to the Council for implementation.

Currently, in many districts, there are no sub-district structures recognised by the law. The Village Registration and Development Act of 1971 provided for the establishment of Ward Development Committees (WDC) in each ward but this was only done in some rural areas. The WDCs are chaired by the Ward Councillor and are largely designated by the Councillor. Most peri-urban areas however, have Residents' Development Committees (RDCs) which are not legally recognised. They are established by District Councils and Councillors sit on these committees as *ex-officio* members. In rural areas alongside these structures, traditional leadership have parallel structures to govern their subjects in terms of traditional and customary law.

Traditional Leadership Structures

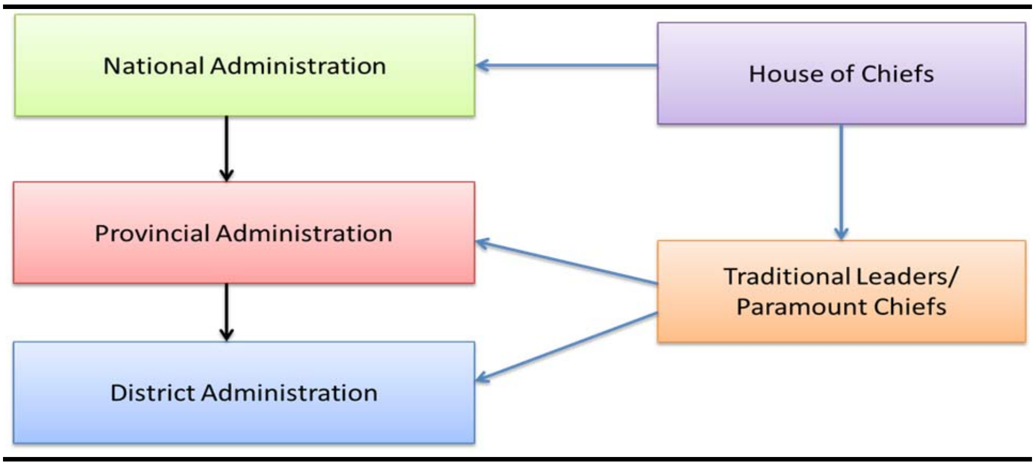
Rural communities of Zambia are led by Chiefs. At national level Chiefs are represented in the House of Chiefs. They act as advisors to the Government with regards to issues relating to the welfare of their respective chiefdoms.

At the village level, the responsibilities of the Chiefs include:

- Dealing with all customary matters in the Districts;
- Governing people in accordance with tribal customs;
- Allocating land through the Headmen/ Headwomen;
- Sensitisation of population for socio-political or developmental activities;
- Conflict and dispute management;
- Representation of villagers at District level;
- Assist District authorities with provision of services in the chiefdoms; and
- Acting as custodians of customary land that falls within their chiefdoms.

The Chiefs are assisted by headmen/headwomen and Councillors in the administration of their chiefdoms. *Figure 8.30* shows the linkages between the political and traditional governance structures in the country.

Figure 8.30 ***Links between Political and Traditional Governance Structures***



8.3.3 Land Tenure and Land Use

This *Section* provides a description of the land tenure systems of Zimbabwe and Zambia as well as their respective land use patterns.

Land Tenure in Zimbabwe

Land rights in Zimbabwe are embedded in four systems of land tenure, namely freehold (private) land, state land, communal land and leasehold (resettlement) land systems. These tenure systems impact and shape the property rights and natural resource access and use regimes in the country.

The freehold tenure system is prevalent in the commercial farming sectors; which occupies about 30 percent of the country's land area; and is characterised by private land ownership. The registered land owner has exclusive property rights and full control and responsibility over the land and everything attached to it, except to the extent that ownership and exclusive control over the land and some natural resources may be limited by statutory provisions.

The communal land tenure system is governed by the Communal Lands Act and is applicable to 40 percent of Zimbabwe's land area, where approximately 66 percent of the country's population resides. According to the Communal Lands Act, all communal land is vested in the State President who has powers to permit its occupation and utilisation in accordance with the Act.

Communal Area inhabitants thus have *usufructuary* [(1)] rights in communal land. Rural District Councils, on the other hand, have the right to allocate land to qualified persons on behalf of the State. Resettlement areas cover ten percent of the country's surface area and are a product of the post-independence period targeted at relieving population pressure on communal areas.

Land Use in Zimbabwe

The State set aside 15 percent of the country land as protected areas (including national parks). Of these areas two percent is allocated to gazetted/protected forests; 13 percent to national parks; 30 percent is used for commercial agriculture, settlements take up 40 percent and the remaining 15 percent is allocated to other land use types.

An estimated 66 percent of the country's land area is under woodland compared to 24 percent under cultivation and ten percent is used for settlements. The heaviest concentrations of indigenous woodlands occur in the gazetted state forests, national parks, the Eastern Highlands and large-scale commercial farms. Land use classifications are presented in *Table 8.26* below.

Table 8.26 Land Classification in Zimbabwe

Land Use	Area (000ha)	% of total
Natural forests	11.60	0.03
Plantations	155.60	0.40
Indigenous woodlands	25,771.40	65.92
Grasslands	1,893.90	4.85
Cultivated land	10,738.10	24.47
Settlements	139.10	0.36
Other	379.40	0.97
Total	**39,089.40**	**100.00**

Source: http://www.fao.org/docrep/005/ab603e/ab603e03.htm

Land Tenure in Zambia

The Zambian Lands Act No. 27 of 1995 classifies land into two types, namely state land and customary land. All state land is vested in the President and he holds the right to give consent to a person, who wishes to sell, transfer or assign any land to a different party. The Commissioner of Lands administers state land for agricultural, commercial, industrial and residential purposes.

(1) one having the usufruct of property or one having the use or enjoyment of something.

Most of the land in Zambia (61 percent) is owned and managed by customary authorities and the remaining 40 percent is owned by the state or privately owned. Of the total customary land in the country an estimated 63 percent (approximately 31 million hectares) is forestland and 24 percent is used for settlements as well as public infrastructure. Approximately five percent of forestland is privately owned [(1)].

Customary land is administered by the Chiefs and the headmen acting with the consent of the communities. Customary land may, however, be expropriated by the State if it is required for development purposes in the national interest and in return for compensation by the State to the affected community or household. This is undertaken in line with the local customary law on land tenure and in consultation with the affected Chief and affected local authority.

One key aspect of customary tenure is that it allows free access to land for all members of a community. In customary areas in Zambia individual ownership, concurrent interests and communal interests are recognised [(2)]. Land can be acquired in the following ways: by simply taking unoccupied land, by being given land as a gift, by the sale of land (with improvements on it [(3)]), by transfer of land in exchange for goods, by transfer of land in exchange of services, by inheritance and by marriage. A stranger to the area must obtain the Chief or headman's permission to settle in the area before he or she can be assigned a piece of land. Similarly, a Chief can prohibit an individual from cultivating in a grazing area. The security of tenure provided under customary laws is almost equivalent to the security provided under freehold. Any individual who establishes residence in a village can acquire customary rights over the land. Other people are then prohibited from laying claim to such land over which another individual has established rights. The rights are permanent unless they are extinguished by abandonment or death.

Land Use in Zambia

Zambia has a total land area of 752,000 km^2. The major land uses in Zambia include forestry and game management areas (66 percent - 49.9 million hectares) and agriculture (32 percent) [(4)]. The classification of land uses are shown in [(5)] *Table 8.27* below.

Table 8.27 Land Use Classification in Zambia

Land Use	Percentage
Deciduous Forest	19.7
Evergreen Forest	1.1

(1) ILUA, 2009

(2) Individual ownership means that the landholder or occupant has more rights and interests in the land than any other person. The individual owns the land for as long as he wishes. Concurrent interests occur where persons, other than the landholder, can go onto someone's land and use it for their own purposes. Communal interests involve the use of certain tracts of land, which are not individually owned

(3) This is the sale of land which has been developed or has some infrastructure on it, etc.

(4) Game Management Areas are set aside principally to serve as buffer zones around the National Parks.

(5) http://www.fao.org/forestry/16955-0c90798cee1e59a8542ede210a9834227.pdf

Land Use	Percentage
Semi-evergreen Forest	45.4
Other natural Forest	0.2
Wooded Grassland	6.5
Shrubs/Thickets	1.5
Grassland	8.1
Lakes	3.6
Marshland	1.8
Annual Crops	6.2
Perennial Crops	0.3
Fallow	3.2
Barren Land	0.0
Pastures	0.6
Rivers	1.0
Rural built-up areas	0.7
Urban built-up areas	0.0

Source: http://www.fao.org/forestry/16955-0c90798cee1e59a8542ede210a9834227.pdf

Community Based Natural Resources Management and Game Management Areas

The Community Based Natural Resources Management (CBNRM) strategies were formulated and implemented in 1988 under the Administrative Management Design Act (ADMADE) conservation program and are primarily carried out in Game Management Areas (GMAs). There are currently 35 GMAs in Zambia. The GMAs are classified as Category VI protected areas (1) in accordance with the International Union for Conservation of Nature (IUCN) classification system and are protected principally to serve as buffer zones around National Parks. Other uses of GMAs are to serve as hunting areas for safari and non-safari purposes; as photographic areas, for non-consumptive utilization and as settlement areas for local communities that also conduct agriculture amongst their other economic activities.

The experiences from ADMADE led to the enactment of the 1998 Zambia Wildlife Act which makes specific provision for the participation of local communities in wildlife management through local institutional structures known as Community Resources Boards (CRBs). CBRs consist of seven to ten representatives elected by the local community; one representative of the local authority and a representative of the Chief in whose area the CRB have been established. The Chief of the area is referred to as the Patron of the CRB.

There are guidelines on how CRBs must be established. Applications to establish a CRB are made by the traditional leaders to the Zambian Wildlife Authority (ZWA), which then facilitates the election process. CRBs provide the link between ZAWA and the local communities. Other functions of CBRs are set out in *Box 8.1.*

(1) Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

GMAs are an important reservoir of wildlife resources and a cornerstone of the implementation of wildlife management strategies. These institutions also act as a vehicle for the distribution of benefits stemming from wildlife to local communities.

Box 8.1 *Functions of Community Resources Boards*

According to the Zambia Wildlife Act the CRB performs the following functions:

- negotiates, in conjunction with ZAWA co-management agreements with hunting outfitters and photographic tour operators;
- manages the wildlife under its jurisdiction, within quotas specified by ZAWA;
- appoint Village Scouts to exercise and perform the duties of a Wildlife Police Officer under the supervision of a Wildlife Police Officer in the area falling under CRB jurisdiction;
- in consultation with ZAWA, develops and implements management plans which reconcile the various uses of land in Game Management Areas/Open Areas; and
- performs other functions as ZAWA may direct or delegate to it.

Source: ZAWA website: http://www.zawa.org.zm/

Conservation/ protected areas closest to the Project Area are highlighted in *Figure 8.31* below.

8.3.4 Demographic Profile

Zambia has a larger population by a million to that of Zimbabwe. Both countries have more women than men by one percentage. This may be attributed to men migrating elsewhere in search of employment and other economic opportunities. Zimbabwe and the project affected provinces have the majority (over 50 percent) of the population fall in the age bracket between 15 to 64 years; while Zambia as whole, has a younger population at 66 percent (under 15 years) (1).

The majority of the population in both countries, its Provinces and Districts resides in rural areas. The only exception is the Kariba District where the majority resides in urban areas. Zimbabwe's population has a relatively high number of female headed households (35 percent) as compared to Zambia which has 19 percent female headed households in the project affected Provinces and Districts. *Table 8.28* provides a summary of the key demographic indicators mentioned above.

Table 8.28 *Demographic Indicators at National, Provincial and District Levels*

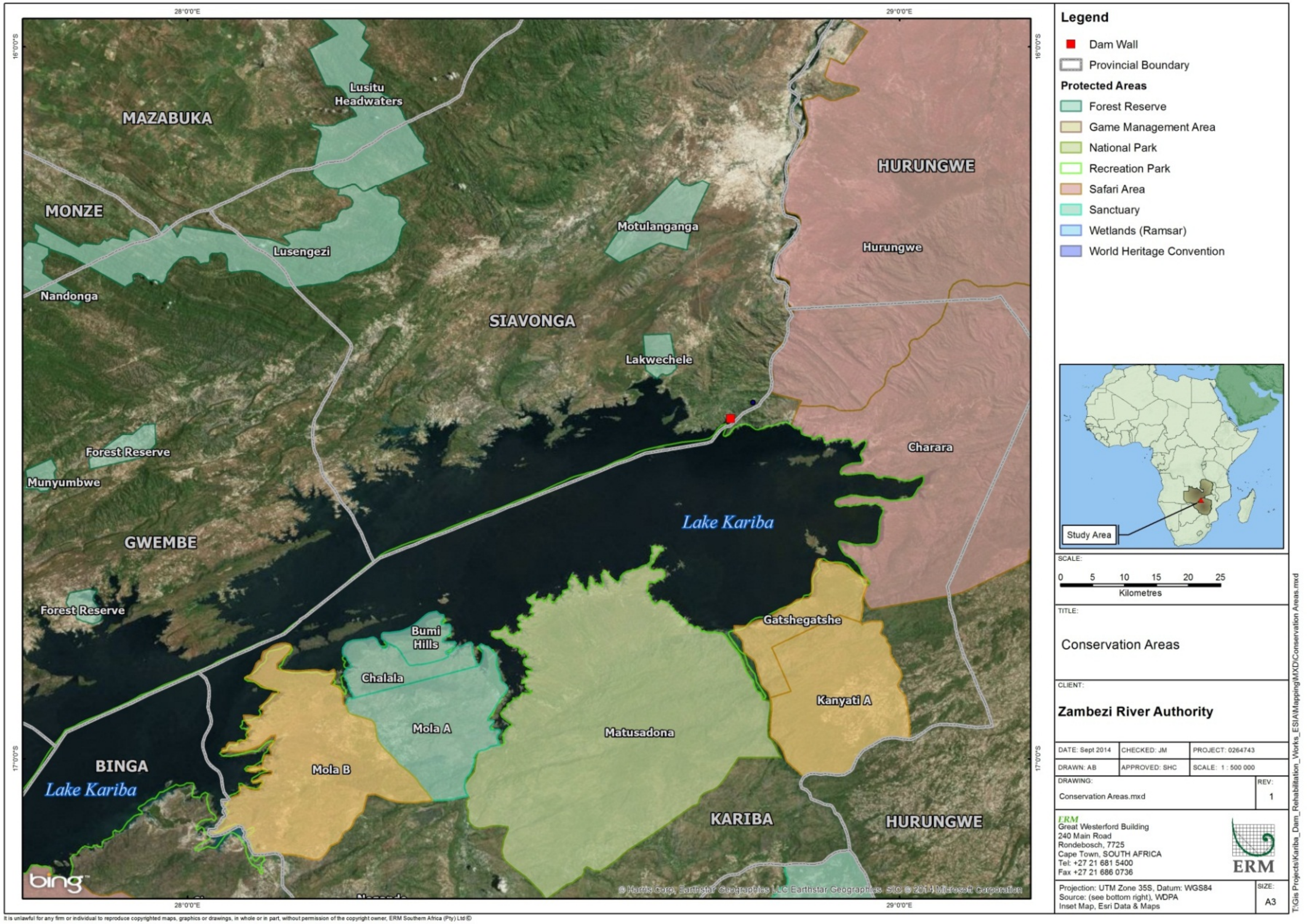
Demographic Indicators	Zimbabwe	Mashonaland West Province	Kariba District	Zambia	Southern Province	Siavonga District
Population Size	13 million	1,5 million	67,820	14 million	1.6 million	89,787
Population Growth	1.1	2.3	-	2.8	2.8	4.4
Population Density	33	-	-	17.4	18.6	26.3

(1) Population Census of Zambia and Zimbabwe, 2011 and 2012 (respectively)

Demographic Indicators	Zimbabwe	Mashonaland West Province	Kariba District	Zambia	Southern Province	Siavonga District
Average Household Size	4.2	4.3	4	5.2	5.4	-
Female and Male Headed Households in %						
Male Headed Households	65	72	-	81.1	82.7	81.8
Female headed households	35	28	-	18.9	17.3	18.2
Gender Distribution in %						
Males	48	48	49	48	47	49.3
Females	52	52	50	52	53	50.7
Age Distribution in %						
Under 15 years	41	22.1	0	66.2	21.2	-
15–64 years	55	81.3	90	31.4	71.3	-
65+ years	4	2.5	10	2.4	2.5	-
Rural/ Urban Split in %						
Urban	33	25	98.7	40	25	35
Rural	67	75	1.3	60	75	65

Source: Zimbabwe National Census Report, 2012; Zambia: 2010 Census of Population and Housing, Population Summary Report. June 2012; Census Report: Mashonaland West Province, 2012; and Siavonga IDP: Status Quo, undated.

Figure 8.31 Conservation Areas Close to the Social Study Area



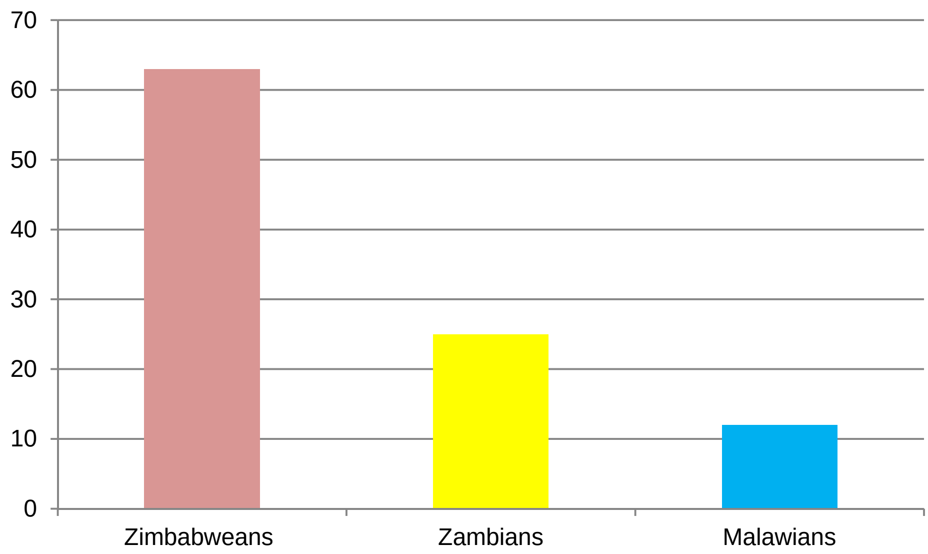
Ward 4, where Mahombekombe is located in the Kariba District, had a population of over 12,500 in 2009. The Kariba Ward (no number available) in the Siavonga District had a population of 16,100 in 2010 [1].

Ethnicity and Language

In Zimbabwe, population groups are classified in terms of three broad categories, namely African origin/Zimbabweans, Foreigners and Others. Zimbabwean citizens account for 99 percent of the population and Foreigners make-up the remaining 1 percent [2].

As mentioned above, the Zimbabwean population is not classified in accordance to ethnicity but rather citizenship. There are two major tribes in the country, namely the Shona and Ndebele people (82 percent and 14 percent of the population respectively). Mahombekombe and Kariba Heights are located within the Mashonaland region which is dominated by the Shona people and language. The surveyed population in the Mahombekombe and Kariba Heights revealed a population dominated by the Zimbabweans at 63 percent including those born in the area and others born elsewhere in the District or Province. Amongst those interviewed, there were also foreign nationals who lived permanently in Zimbabwe; *i.e.,* Zambians and Malawians as indicated as indicated in *Figure 8.32* below.

Figure 8.32 Tribal-linguistic groups in Mahombekombe and Kariba Heights



In contrast, Zambians are classified in accordance to their ethno-linguistics (which excludes foreign nationals), with people of Bemba origins dominating the population groups at 27 percent at a national level; followed by the Tonga at 19 percent. Other ethno-linguistic groups include the Chewa (ten percent), Lozi and Nsenga (nine percent), Tumbuka and Ngosi (six percent) Lala and

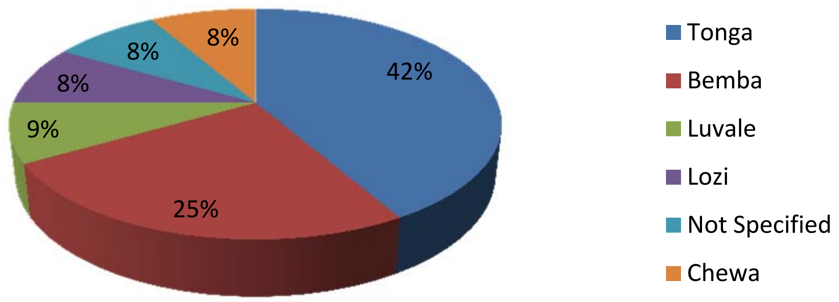
(1) Siavonga IDP Status Quo, undated
(2) Zimbabwean Population Census, 2012

Kaonde (five percent) and Luanda (four percent) account for the remaining population.

At a **Provincial and District** levels (Southern Province), the Tonga people dominate the population at 70 percent, whilst the other ethno-linguistic groups exist in smaller percentages including the Nyanja (5.5 percent), Lozi (five percent), Ila (3.8 percent), Bemba (2.8 percent), and English at 0.8 percent.

Of the total population surveyed in Siavonga Town and Micho, an estimated 42 percent were of Tonga ethno-linguistic groups, followed by the Bemba's at 25 percent and other ethno-linguistic groups made up the remaining 33 percent as indicated in *Figure 8.33* below.

Figure 8.33 Ethno-linguistic Groups in Micho and Siavonga Town



Migration Trends of the Population

<u>*National*</u>

In both countries, inter-migration are high and it is fuelled by the search for employment and business opportunities. In Zambia, there is a lack of valid data about the numbers of cross-border migrants (both regular and irregular) as well as internal migrants [(1)] compared to Zimbabwe. According to the IOM, both inter– and out- migration in Zambia takes place in search of improved livelihoods; *i.e.*, in search of work (i) in the mines of the Copperbelt Province; (ii) on commercial farms; (iii) in small-scale fishing and fish trading; and (iv) as truckers along the transport corridors that link the country with its neighbours. Natural disasters such as droughts and floods also play a major role in inter-migration patterns of the population. It is, however, assumed that the reasons for in-and-out migration in both countries are similar; as such trends have also been observed in other African countries.

In turn, in Zimbabwe, the Provinces of Harare and Bulawayo had the highest in-migration of 49 percent, respectively from 2002 to 2012. These provinces were followed by Mashonaland East at 33 percent and Mashonaland West at

(1) International Migration Organisation, June 2011

30 percent. The same provinces with high in-migration also experienced the highest out-migration, with Bulawayo and Harare at 39 percent, respectively. Overall, the same provinces also experienced positive net migration; in turn, the other provinces experienced less in-and-out migration resulting in negative net migration rates, as indicated in *Table 8.29* below.

Table 8.29 Migration Pattern of Zimbabwean Population

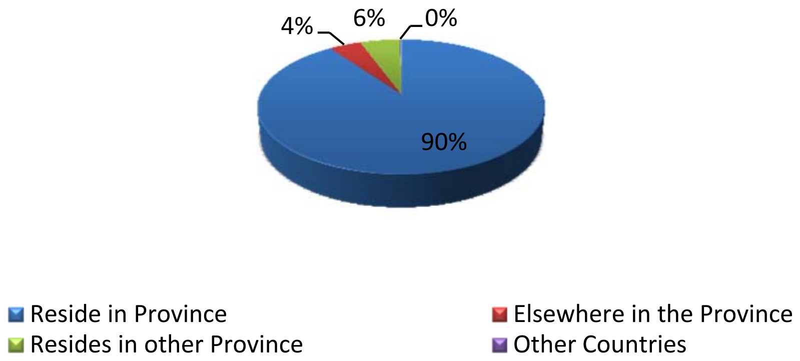
Province	In-migration	Out-migration	Net Migration Rate
Bulawayo	49.1	39.4	19.1
Manicaland	14.8	24.9	-11.8
Mashonaland Central	20.7	23	-2.9
Mashonaland East	32.7	33.9	-1.9
Mashonaland West	29.9	23.9	8.5
Matabeleland North	19.4	20.5	1.3
Matabeleland South	24.9	22.4	-3.3
Midlands	23	25.7	-3.5
Masvingo	15.6	27	-13.5
Harare	49.2	38.6	21

Source: Census Report: Mashonaland West, 2012

Provinces

A similar trend of lack of migration data in Zambia continued to the Provincial levels. In Mashonaland West (Zimbabwe), an estimated 25 percent of the population resided in urban areas. There was a sizeable movement of people from District to District and also from other Provinces. About five percent of the population in Mashonaland West Province usually resided in other provinces and the main contributor was Harare. Overall, approximately 90 percent of the population in the province usually resided within the Province; see *Figure 8.34*.

Figure 8.34 Migration Trends Mashonaland West Province



Districts

As with the national and provincial levels, there is no data on population in-migration Zambia. However, from the stakeholder consultation it was clear that a majority of people currently residing in Siavonga Town are migrants from other parts of Zambia. This portion of the population either works in government, own businesses or trade in the district.

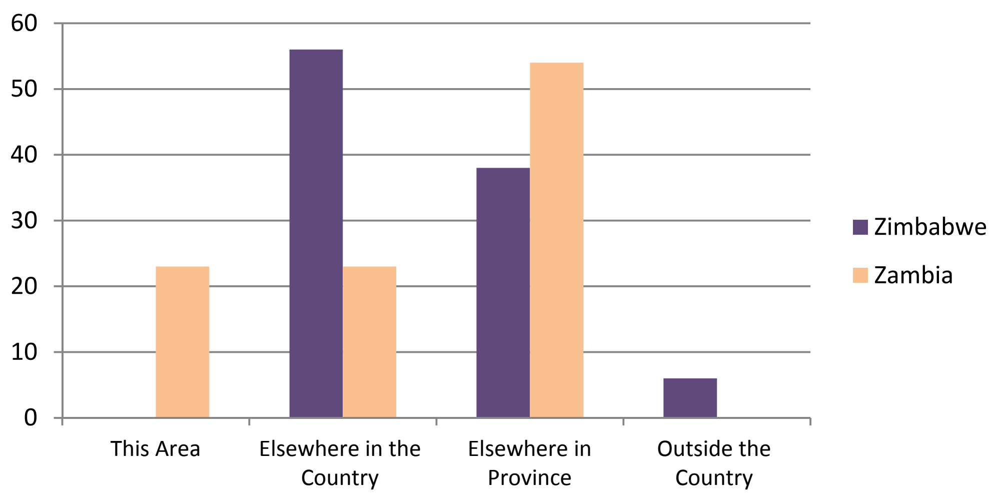
In Kariba Rural District, about 93 percent of the population usually lived in the same district. Four percent was from other districts within the same province, three percent from other provinces with Midlands being the main contributor. Eighty-four percent of the population usually resided in the same district, 10 percent in other districts and six percent in other provinces. Harare and Mashonaland Central were the largest contributors of people from other provinces.

<u>*Social Study Area*</u>

Of the people surveyed in Mahombekombe and Kariba Heights (Zimbabwe) and Micho and Siavonga Town (Zambia), the majority reported that they were migrants from elsewhere in the province or country. In Zimbabwe, the majority of population interviewed (56 percent) reported that they were from elsewhere in the country; while their Zambian counterparts reported that they were from elsewhere in the Southern province (at 54 percent); see *Figure 8.35*. One foreign national was interviewed in Kariba Heights who reported that she was Malawian.

They all stated that they moved into the areas around Lake Kariba in search of employment and business opportunities within the formal and informal sectors of the economy. One of the District officials in Zambia reported that the majority of the population that reside in the Siavonga moved to the area to partake in the fishing and tourism activities; while a small percentage move to the area work for government (these people include teachers, district officials, and health workers).

Figure 8.35 Place of Birth of the Population in Percentages



8.3.5 *Vulnerable Groups*

In the SSA, the broad categories of people who should be considered to have some level of vulnerability include:

- Women;
- The elderly;
- Youth; and
- Disabled or chronically ill persons.

These groups are described in more detail below.

Women

Women are generally regarded as vulnerable in the African social context as they are often expected to fulfil traditional roles of women i.e., taking care of the household and raising children rather than seeking formal employment. In many cases women also lack education, mostly having attained only primary school level education. As such local women are unlikely to seek employment with the Project because of family duties.

The Elderly

The elderly are generally recognised as being vulnerable. The elderly remain in high social standing as long as they are productive; however, they lose this standing once they become dependent on the younger generations for assistance in meeting their basic needs (e.g., housing, water, food). The elderly are usually not in a position to take advantage of the benefits typically associated with large projects such as the Kariba Rehabilitation Project.

Youth

For the purposes of this assessment, youth are quantitatively defined as persons aged approximately 15 to 24 or, recognising variations by cultural context, qualitatively defined by their degree of independence with respect to their ability to secure a livelihood, their relationship status (i.e., marriage, children), and living arrangements.

Youth can be recognised as vulnerable, though in a way distinct from other categories listed above. Being at their physical prime but often facing an unknown future, youth may be seen as both empowered and disempowered. Youth are vulnerable in the sense that they are between dependence (childhood) and independence (adulthood) and, without access to resources and support to enable their transition to adulthood, youth may face a large degree of instability in their lives. Youth only inherit land once they have reached full adulthood and marriage, and until then are dependent on their parents.

Disabled or Chronically Ill Persons

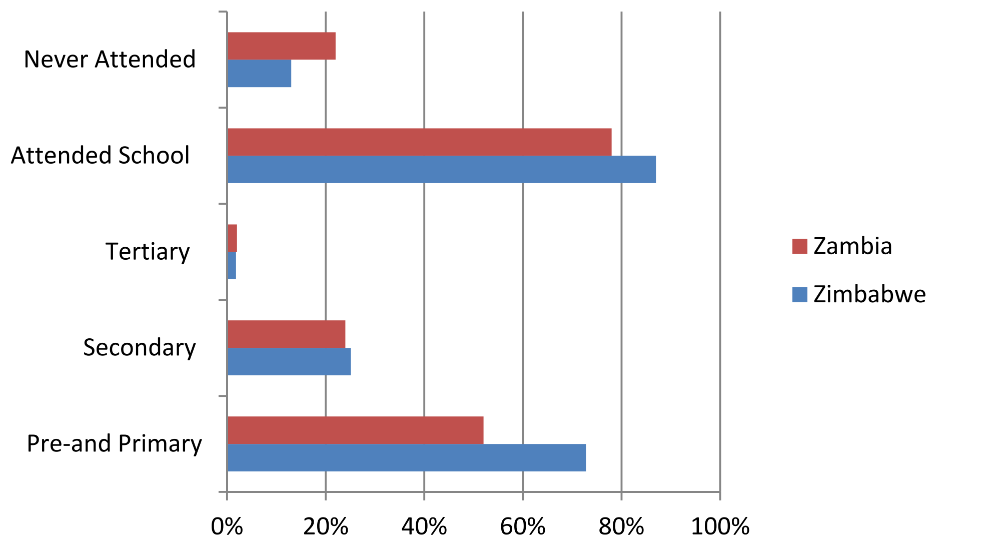
Disabled persons should be recognised as vulnerable as they are unlikely to be able to access the Project benefits but would also be vulnerable to change brought about by the Project. People living with HIV/AIDS and TB can be considered to be disabled as their ability to remain healthy and maintain their livelihoods is often compromised by their illness.

8.3.6 Education

National

Zimbabwe and Zambia have a dual education system that comprises of primary and secondary schooling. For both countries, primary education takes the most years to complete seven (Zimbabwe) and nine (Zambia) years. The literacy levels of the population in both countries (Zimbabwe and Zambia) are regarded as high, especially amongst the youth (aged 15 to 24 years old); at 96 and 78 percent respectively. There are some youths in both countries that are illiterate as they have not received any schooling; see *Figure 8.36* below for further details.

Figure 8.36 Education Levels



Source: Zimbabwe National Census Report, 2012; Zambia: 2010 Census of Population and Housing, Population Summary Report. June 2012

Provinces

A high percentage of the Southern Province population (44 percent) was recorded as illiterate; while in Mashonaland West Province, only 13 percent of was reported as being illiterate [(1)]. The differences in literacy levels between the two can be attributed to the following (based on general knowledge of the two countries and interviews with locals):

(1) Southern Province: Provincial Development Plan, undated

- After the Zimbabwean independence a significant emphasis was placed at educating the population, to such an extent that the country ended up with a large proportion of its population with having a tertiary education.

- Scattered settlement patterns in Zambia and lower school numbers in rural parts of the country has resulted in lower education levels relative to those in Zimbabwe.

An estimated 57 percent of the population in Mashonaland West were attending school in 2012 (1). The proportion of the population aged 3-24 years, that had left school at the time of the census was 30 percent. In turn, in the Southern Province; school attendance at primary/basic school level was an estimated 86 percent during the 2000 Population Census. This revealed a three percent increase to primary/basic school level attendance compared to the 1990 Census. In the Southern Province, the numbers of students at secondary school during the same Census year were low at 60 percent. The attendance amongst females was lower at 49 percent compared to their counterparts at 63 percent. This was experienced mainly in the rural areas where early marriages are common practise. This development illuminates the growing imbalance in secondary education provision between the rural and urban areas.

Districts

Kariba had 30 primary schools with a total enrolment of 12,959 pupils comprising of 6,435 (51 percent) boys and 6, 524(49 percent) girls, indicating more boys than girls attend primary school in the area (2). There were 343 trained teachers at the schools; a teacher pupil ratio of 1:36 which is slightly less than the national average of 1:43 (3). Of the 30 schools, three were government owned; four owned by the local Town Council, while 23 belonged to the Rural District Council.

In 2011, Kariba has eleven secondary schools, which comprises of 2,144 boys and 1 698 girls (4). The total enrolment for all the schools in 2011 was an estimated 3,842 pupils (5). The teacher pupil ratio of 1:22 which is relatively low compared to the national teacher pupil ration of 1:43. Of the 11 schools, only one school was government owned one belonged to the Town Council whilst the remaining nine were owned by the Rural District Council (6). It is unclear how this divide in school ownership is derived.

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(1) Zimbabwean Population Census: Mashonaland West, 2012

(2) Parliament Research Department: Kariba Constituency, 2011
(3) Parliament Research Department: Kariba Constituency, 2011
(4) Parliament Research Department: Kariba Constituency, 2011
(5) Parliament Research Department: Kariba Constituency, 2011
(6) Parliament Research Department: Kariba Constituency, 2011

Table 8.30 *Schools in Kariba District*

Types of Schools	Number of Schools	Ownership		
		Government	Town Council	Rural District Council
Primary	30	3	4	23
Secondary	11	1	1	9

Siavonga had 64 schools in 2010, these included nurseries, primary and high schools; as indicated in *Table 8.31* below [(1)].

Table 8.31 *Schools in Siavonga District*

Type of School	Number	Ownership		Number in Planning Area	
		Govt.	Private	Govt.	Private
High Schools	5	4	1	1	0
Basic Schools	35	33	2	2	0
Community Schools	20	0	0	4	0
Elementary (Pre/Nursery School)	4	0	4	0	4

There has been an increase in school enrolment in the Siavonga District since 2009, which has been attributed to basic education being free. In 2009 an estimated 19,467 pupils were enrolled in Siavonga schools; of which 8,182 (42 percent) were girls while 11,285 (58 percent) were boys, see *Table 8.32* below.

Table 8.32 *School Enrolment in Siavonga District in 2009*

Category of Schools	Year 2009		
	Boys	Girls	Tota`l
Basic Schools (Grades 1 – 4)	4293	2266	6,559
Basic Schools (Grades 5 – 7)	2556	2227	4783
Basic Schools (Grades 8 – 9)	1215	960	2175
Secondary Schools (Grades 8 – 12)	-	186	186
(Mubuyu Christian Academy)	-	-	-
High Schools (Grades 10 – 12)	857	466	1323
Schools for Continuing Education	-	-	-
Community Schools	1885	1840	3725
Interactive Radio Instruction (IRI)	382	334	716
Grand Total	**11,285**	**8,182**	**19,467**

As for the Kariba District, an estimated 7,538 pupils were enrolled in Kariba schools; of which 3,857 (51 percent) were girls while 3,681 (49 percent) were boys, see *Table 8.33* below.

(1) Siavonga District Status Quo, undated

Table 8.33 School Enrolment in Kariba District in 2012

School Levels	Male	Female	Total
Pre-School	9.2	9.7	9.4
Primary	56.3	55.7	56
Secondary	33.2	33.2	32.6
Tertiary	2.4	1.2	1.8
Other	0.2	0.2	0.2
Total percentage	100	100	100
Number	3,681	3,857	7,538

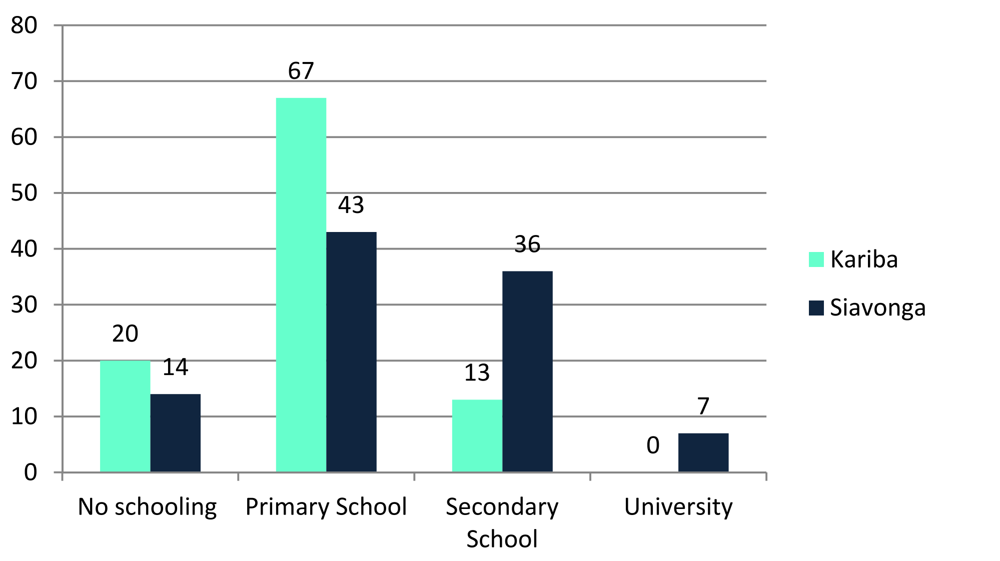
Source: Zimbabwean Population Census: Mashonaland West, 2012

Social Study Area

Amongst the adults interviewed 20 percent in Kariba (Zimbabwe) reported that they had no schooling. In turn, only 14 percent of the participants in Siavonga (Zambia) reportedly had not received any schooling.

Of the same groups, a large portion of the Kariba (Zimbabwe) group had primary schooling (67 percent); while in Siavonga (Zambia) only 43 percent had primary schooling. In contrast, a larger portion of the Siavonga population had secondary level education compared to those from Kariba at 36 and 13 percent, respectively; see *Figure 8.37* below.

Figure 8.37 Education Levels of the Kariba and Siavonga (Surveyed Population only) in Percentages



<u>Please Note</u>: the sample size for the surveyed population was 44 for Kariba District and 40 for Siavonga.

8.3.7 *Health*

Health services in Zimbabwe are divided into four levels of care: primary, secondary, tertiary, and quaternary; while the Zambian health services are divided into three levels namely Rural/Urban Health Centres, District Hospitals and General Hospitals [1]. The Zimbabwean health facilities and health care provided at the different levels are summarised in *Table 8.34* below.

Table 8.34 ***Health Care in Zimbabwe***

Levels	Description	Type of health care provided
Primary health care	This type of care is given by village health workers, community-based distributors and at small clinics/facilities. These services are particularly prevalent in rural areas. Primary health care facilities comprise of 78 percent of the total number of health facilities in the country. This level of health care consists of 1,118 rural health clinics, rural hospitals, and urban polyclinics.	Health care at this level tends to be basic prevention, as well as maternity and curative services; most facilities are managed by a nurse, or sometimes a number of nurses in larger urban areas. Complicated cases are referred to the District Hospitals. Primary care facilities are administered by community, ward, and rural health committees, and are under the supervision of the DHO.
Secondary health care	Secondary care consists of facilities that receive patients via referrals from the primary care facilities. These facilities account for three percent of the total number of health facilities in the country. These include 46 district hospitals and five mission hospitals. District hospitals are administered by a hospital and district health committee.	Services at this level should be able to deal with emergencies referred from primary care facilities; in practice, many of these facilities, especially the district and mission hospitals, are the closest health facility for a community, and therefore they also provide primary health care services. For specialty health services, or more complex health matters than what the district health staff can treat, district facilities may refer patients to tertiary health facilities.
Tertiary health care	Tertiary health care consist of Provincial hospitals and account for one percent of the total number of health facilities in the country. There are 7 such facilities available. Tertiary care is also available at some private clinics and hospitals located in Zimbabwe's largest cities. Many of the private clinics tend to be too expensive to afford for most Zimbabweans.	Provincial hospitals receive referral patients from district hospitals and have specialists on their staff to deal with complex health matters. However, the unique and extremely complicated cases are referred to the six central hospitals. These hospitals receive patients from all the provinces of Zimbabwe.
Quaternary/central care	Quaternary or central care consists of six central hospitals distributed over Bulawayo, Harare, and Chitungwiza. These hospitals have the most advanced equipment, staff, and pharmaceuticals for dealing with severe illnesses and medical cases.	The central hospitals have the largest specialist and clinician staff complement. These hospitals are the highest level of health referrals. Central hospitals report directly to the MOHCW.

Source: http://www.healthsystemassessment.com/wp-content/uploads/2012/06/Zimbabwe_Health_System_Assessment2010.pdf

(1) http://www.healthsystemassessment.com/wp-content/uploads/2012/06/Zimbabwe_Health_System_Assessment2010.pdf

The health systems in Zambia are classified into three major categories:

- **First Level Services** – comprising of health posts, rural health centres and district hospitals, where primary healthcare and preventive health services are provided.
- **Second Level Services** – comprising the provincial and general hospitals, which provide the curative care.

- **Tertiary Level Services** – comprising a central hospital and the national university teaching hospital which provide specialized care.

The Zambian health facilities and health care provided at the different levels are summarised in *Table 8.35*.

Table 8.35 Health Care in Zambia

Levels	Description	Type of health care provided
Health Posts	These are the lowest levels of health care and are built in communities far away from health centres. Currently, there are 307 Health Posts in the country. These cater for a catchment population of approximately 3,500 in rural areas and 1,000 to 7,000 in the urban settings and are set up within five kilometres radius for sparsely populated areas.	The types of health services offered at this level are basic first aid rather than curative.
Health Centre	There are two types of health centres in the health care delivery system in the Zambia These include urban health centres or clinics (UHC). These serve a catchment population of between 30,000 to 50,000 people; and Rural Health Centre (RHCs) which serves up to 10,000 people.	The centres act as the first level referral points where a person cannot be assisted at a health post. There were 409 Urban Health Centres and 1,131 Rural Health Centres in 2012.
First Level Hospitals	First level hospitals, also referred to as District Hospitals are found at district level. These serve a population of between 80,000 and 20,000 and provide services such as medical, surgical, obstetric and diagnostic services and all clinical in support of health centre referrals.	These serve as the second and third level referral hospitals. There were 84 first level hospitals in 2012.

Levels	Description	Type of health care provided
Second Level Hospitals	Second level hospitals, also referred to as Provincial or General Hospitals, and they are found at provincial level. They are intended to cater for a catchment area of between 200,000 and 800,000 people.	The services provided include general surgery, paediatrics, obstetrics and gynaecology, dental, psychiatry and intensive care services. These hospitals also act as referrals for the first level institutions, including the provision of technical back up and training functions. There were 19 Second Level Hospitals in 2012.
Third Level Hospitals	Third level hospitals also called specialist or tertiary hospitals and they are the highest referral hospitals in the country. These hospitals cater for a catchment population of approximately 800,000 and above, and	These provide medical services to all complicated cases not attended to at second level hospitals and serves as referral for the third level hospitals. The services provided by this level including surgery, paediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research. In 2012, there are 6 third level hospitals in the country.

Source: http://www.moh.gov.zm/docs/facilities.pdf

The provision of health care is poor in both countries. Their health care budgets are below the Abuja Declaration's goal for health care budgets at a target of 15 percent of a country's total budget. In 2009, the total health expenditure in Zimbabwe was USD 42.5 million, which was a significant increase from previous years and approximately 4.8 percent of their GDP [(1)].

The life expectancy in both countries is 57 years and 58 years respectively for Zambia and Zimbabwe. Zambia has a higher death rate to that of Zimbabwe at 11 percent and 10 percent respectively [(2)]. Zambia has a higher birth rate than Zimbabwe at 43 percent in relation to the 32 percent of Zimbabwe.

The prevalence of HIV/Aids is slightly lower in Zambia compared to Zimbabwe at 13 percent and 15 percent respectively [(3)]. It is reported that condom use as a means of HIV/Aids prevention as well as comprehensive knowledge of HIV/Aids is lower in Zambia than in Zimbabwe [(4)]. Further information on health indicators for each country are summarised in *Table 8.36* below.

(1) CIA World Fact Book
(2) http://www.unicef.org/infobycountry/zimbabwe_statistics.html; http://www.unicef.org/infobycountry/zambia_statistics.html
(3) http://www.unicef.org/infobycountry/zimbabwe_statistics.html; http://www.unicef.org/infobycountry/zambia_statistics.html
(4) http://www.unicef.org/infobycountry/zimbabwe_statistics.html; http://www.unicef.org/infobycountry/zambia_statistics.html

Table 8.36 Health Indicators

Indicators	Zambia	Zimbabwe
Crude death rate	10.7	9.7
Crude birth rate	43	31.6
Life expectancy	57	58.1
Total fertility rate	5.7	3.6
HIV/AIDS		
Adult HIV prevalence (%)	12.7	14.7
People of all ages living with HIV(estimated number)	1,100	1,400
Women living with HIV (total number)	490	700
Children living with HIV (total number)	160	180
Percentage using HIV preventative measures among young people (aged 15-24), (%), total	4.1	5.1
Percentage using HIV preventative measures among young people (aged 15-24), Comprehensive knowledge of HIV (%), male	40.7	47
Percentage using HIV preventative measures among young people (aged 15-24), Comprehensive knowledge of HIV (%), female	37.8	51.9
Percentage using HIV preventative measures among young people (aged 15-24), Condom use among young people with multiple partners (%), male	43.1	50.5
Percentage using HIV preventative measures among young people (aged 15-24), Condom use among young people with multiple partners (%), female	41.5	38.5
Orphans, Children orphaned by AIDS	670	890
Orphans, Children orphaned due to all causes	1,400	1,200

Source: http://www.unicef.org/infobycountry/zimbabwe_statistics.html; http://www.unicef.org/infobycountry/zambia_statistics.html

Provinces

In Mashonaland Province, Acute Respiratory Infections (ARI), malaria, skin diseases and injuries are the five major causes of going to a health facility. Tuberculosis (TB), ARI, HIV/AIDS, malaria and other viral diseases are reported to be the top five causes of mortality [(1)].

The overall crude death rate in the Mashonaland Province is an estimated 11 deaths per 1,000 people. Chegutu Rural and Hurungwe Districts experience the most deaths at 12 deaths per 1,000 people [(2)].

(1) Population Census: Mashonaland West Province Report, 2012

(2) Population Census: Mashonaland West Province Report, 2012

The birth rate for the **Mashonaland West Province** was recorded at of 4 children per female. When comparing the birth rate to the education levels of the women; women with higher educational had less children compared to the ones with low education levels [(1)]. The infant mortality rate is estimated at 65 deaths per 1,000 births and infant mortality was high in rural areas as compared to urban areas [(2)]. This is likely due to rural women not proactively seeking prenatal care. HIV prevalence in the Mashonaland West Province is 15% (Kerina *et al.* 2013), with an estimated 58,754 new cases of AIDs cases reported in the Province in 2011 (The Zimbabwe National Health Profile, 2011).

Extreme poverty can contribute to health problems in **the Southern Province**. An estimated 47.3 percent of the population is affected thereby [(3)]. This despite the fact, that the incidence of poverty has reportedly declined from 73 percent of the total provincial population in 2006 to 68 percent of the total provincial population in 2010 [(4)]; thus representing a decline of 5.1 percent in poverty. The incidence of poverty is generally higher in rural areas than urban areas. Female headed households are generally most vulnerable to the incidence of poverty. Poverty is highest amongst those people with a lower level of education, the unemployed and non-farming communities.

The HIV/Aids infection rate in the province is estimated at 14.5 percent. Of those with HIV/Aids, 17.4 percent receive antiretroviral treatment [(5)]. The province has a total of 53 health facilities that are able to provide antiretroviral medication to adults and children. In the population age bracket, 15 to 24 years, females have a more comprehensive and accurate knowledge and understanding of HIV/Aids than males [(6)]. However, knowledge does not equate to prevention of infection with HIV/Aids and the population between 15 and 24 years, remains at a higher risk than other age groups to be infected with HIV/AIDs.

Districts

The Siavonga District has a health facility for each of its catchment areas. This includes two District hospitals and 12 health posts and centres [(7)]. In 2010, malaria, malnutrition, respiratory infection (pneumonia), anaemia, diarrhoea (non-blood), severe diarrhoea with dehydration, and poisoning were the main causes of deaths [(8)]. It is estimated that the HIV prevalence rate in the Siavonga District is 15.70%, and of those who are HIV positive it is estimated that 42.33% are woman (Zambian National HIV/Aids/STI/TB Council, 2010).

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(1) Population Census: Mashonaland West Province Report, 2012
(2) Population Census: Mashonaland West Province Report, 2012
(3) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013
(4) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013
(5) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013
(6) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013
(7) Siavonga IDP Status Quo, Undated
(8) Siavonga IDP Status Quo, undated

There are 12 health centres in Kariba District and these consist of one district hospital and five clinics. All the health centres have access roads, access to electricity and sewerage systems. The Kariba Urban Primary Health Level comprises of Nyamhunga and Mahombekombe clinics that provide the first point of contact between the communities, Home Based Care Givers (HBCG) and the formal health delivery system. This level provides comprehensive, promotive, preventative, curative and rehabilitative health services. The crude death rate in Kariba is 10 per 1,000 people. Common illnesses include cholera, malaria, upper respiratory tract infections, HIV/Aids and others. No HIV/Aids statistical data could be obtained for the Kariba District.

8.3.8 Economy and Livelihoods

This *Section* provides an overview of the economic and livelihood activities in the respective countries, provinces and districts.

National

In Zimbabwe, the growth rate of the gross domestic product (GDP) decelerated to 3.7 percent in 2013, from 4.4 percent in 2012 (1). According to the African Economic Outlook, the economic deceleration was due to limited sources of capital, policy uncertainty, and the high cost of doing business. In 2013, the economy experienced a decline in most economic sectors that had previously made high contributions to the GDP such as the agricultural and mining sectors. In turn, sectors that had contributed less to the economy in 2012, contributed the most in 2013. These include the wholesale and retail trade, hotels and restaurants sector, manufacturing, other services; finance, real estate and business services and construction sectors; see *Table 8.37*.

In 2013, the "wholesale and retail trade, hotels and restaurants" sector of the economy overtook the agricultural sector and became the highest contributor to the country's GDP at 15.3 percent. This sector was followed by manufacturing (13.6 percent), and the agriculture, hunting, forestry, fishing sectors at 13.1 percent (which signified a drop of seven percent) (2).

Table 8.37 Sectorial Contribution to the GDP: Zimbabwe in 2013

Economic Sectors	Percentage to GDP
Wholesale and retail trade, hotels and restaurants	15.3
Manufacturing	13.6
Agriculture, hunting, forestry, fishing	13.1
Transport, storage and communication	12.8
Other services	12.3
Finance, real estate and business services	11.3
Mining	10.1
Electricity, gas and water	4.3
Public administration, education, health and social	3.7

(1) African Economic Outlook: Zimbabwe, 2014
(2) African Economic Outlook: Zimbabwe, 2014

Economic Sectors	Percentage to GDP
work, community, social and personal services	
Construction	3.6

Source: African Economic Outlook: Zimbabwe, 2014

The Zambian economic growth is said to have decreased to 6.5 percent in 2013 due to the fall in agricultural output, particularly maize and cotton (1). The growth in real GDP was largely driven by manufacturing, mining, construction, transport, communications and the public sector in 2013, see *Table 8.38*. Copper mining remained the economy's main support, and contributed an estimated 70 percent to the country's export earnings. The country's GDP was projected to grow to approximately 7.1 percent in 2014 and 7.4 percent in 2015 (2).

Table 8.38 Sectorial Contribution to the GDP: Zambia in 2013

Economic Sectors	Percentage Contribution to GDP
Agriculture, hunting, forestry, fishing	17.7
Agriculture (of which fishing)	0.5
Mining (of which oil)	2.2
Manufacturing	8.2
Electricity, gas and water	3
Construction	15.1
Wholesale and retail trade, hotels and restaurants	1.9
Transport, storage and communication	3.9
Finance, real estate and business services	9.2
Public administration, education, health and social work, community, social and personal services	2.9
Other services	8.8

Source: African Economic Outlook: Zambia, 2014

The Zambian Government has recognised that there is a lack of diversity in its economy and has outlined growth targets in Zambian Vision 2030 to create more diverse opportunities. The plan involves continued development of the historically dominant sectors, namely industry and tourism. In addition, emphasis is now being placed on modernising the agricultural sector, improving efficiency and productivity in the services sector and expanding the mining sector (3) further.

Agriculture remains a key livelihood activity, particularly in rural areas. Over 80 percent of the population depends on agriculture-related activities for their livelihoods (4). The government acknowledges the challenges facing the agricultural sector namely:

- Farming activities are mainly undertaken for subsistence reasons. It makes a minimal contribution to the earning of export revenue for the country.

(1) African Economic Outlook: Zambia, 2014
(2) African Economic Outlook: Zambia, 2014
(3) Zambia Vision 2030
(4) Six National Development Plan, 2011 - 2015

Agricultural activities have high production costs further compounded by limited access to long-term financing and credit services.

- The agricultural sector suffers from a shortage of skills, particularly for veterinary and extension services.

As part of addressing the above challenges and growing the agricultural sector, government is planning to improve the allocation of necessary resources to the agricultural sector, increase investments in agricultural infrastructure as well as ensure crop diversification. This is discussed in *Box 8.2* below.

Box 8.2 Government's Plans to Improve Agricultural Activities in Zambia

To boost **crop and livestock production diversification,** the government plans to expand coverage of the Farmer Input Support Programme to other crops such as soya, cotton, sunflower, and rice.

To alleviate delays in input distribution which impacted negatively on the sector in 2012, government plans to introduce an **electronic voucher (e-voucher)** system from 2013. The e-voucher system is expected to strengthen the role of the private sector in supplying agricultural inputs.

Livestock restocking, streamlining of policy and scaling-up of extension services, irrigation and research are additional policy measures being undertaken to increase agricultural productivity.

Source: African Economic Outlook: Zambia, 2012

Provinces

The economy of Mashonaland West is dominated by the **agricultural sector** and includes commercial, communal and subsistence farming. Commercial crops produced include cereals (wheat and maize), soya beans, tobacco, sugar beans, groundnuts and sunflowers. Over 70 percent of the country's total pig population [(1)] is produced in the Province.

Mining: mineral resources are found mainly along the Great Dyke that is in the Kadoma and Gweru Mining Districts in the Mashonaland West and Midlands provinces, respectively. In addition, other mines are scattered throughout the country. Mashonaland West is known for mining gold, silver, chrome, iron pyrites, limestone, nickel, silica and platinum.

Tourism: is focused in and around Lake Kariba and the Chinhoyi Caves. Fishing and other water-based tourism activities are two of the most popular tourist activities.

Other major economic sectors include fishing, construction, law and security, as well as the business and finance sectors.

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010

Agriculture (both livestock and crop production) form the primary economic activity in the Southern Province of Zambia. Crop production is undertaken both on a commercial and subsistence scale. Cash crops include cotton, tobacco and oil seeds; whilst food crops consist of maize and sorghum. More than 90 percent of the Province's income is derived from agriculture (1). Currently, the agriculture sector in the Province has a share of 18-20 percent in the Gross Domestic Product (GDP) (2). In *Table 8.39* the food and cash crops production statistics for the 2005/6 production season is illustrated.

Table 8.39 Food and Cash Crops Production in 2005/6: Commercial and Small-scale

Crop Type	Commercial ton/ha	Small-scale ton/ha
Small Scale Crops		
Maize	4.43	2.36
Sorghum	0.9	0.47
Millet	5.5	0.3
Commercial Crops		
Cotton	1.6	0.86
Sugar cane	136	-
Tobacco	2.13	1.04

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Livestock production is an important activity to both commercial and small-scale farmers. It is also an important cultural heritage activity of the Tonga people. The most popular livestock produced are cattle. However, the cattle population has drastically declined over the past years due to diseases such as corridor disease. The livestock sector in Southern Province comprises around 700,000 cattle; 317,100 goats; 25,100 sheep; 46,200 pigs and 542,500 poultry (3). Poultry production is estimated at one million broiler birds per year. There are 50,000 commercial layers for egg production in the commercial and small-scale sector. This is illustrated in *Table 8.40* following.

Table 8.40 Livestock Population Trends in the Southern Province

Livestock	Year				
	2003	2004	2005	2006	2007
Cattle	580,065	613,859	642,252	667,785	784,451
Goats	267,449	291,104	282,589	317,106	332,035
Sheep	20,815	20,646	19,870	25,048	34,593
Pigs	42,967	51,799	42,378	46,200	61,647
Poultry	489,241	585,646	494,293	542,553	600,832
TOTAL	**820,472**	**949,195**	**839,130**	**930,907**	**1,029,107**

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Forests in Southern Province are estimated to cover an area of about 6,600,000 ha representing more than 70 percent of the total land area of the Province. About half of this area (3,210,000 ha) is gazetted as Game Management Areas

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010
(2) Provincial Strategic Plan: Southern Province, 2008 – 2010
(3) Provincial Strategic Plan: Southern Province, 2008 – 2010

(GMA), National Parks (NP) and Forest Reserves (FR). [1]. Forests play a vital role in people's socio-economic well-being: it provides food in the form of fruit, tubers, wild vegetables, bush meat, edible insects, mushrooms and honey. Forests are also sources of medicine, wood-fuel and building materials for the rural population. The Joint Forest Management (JFM) of the Province revealed that the contribution of forests to household income in the area ranged between 5 percent to 70 percent of the household income and averages at 17.1 percent [2].

Fishing is also an important economic and livelihoods activity in the Southern Province. The fisheries are situated on the middle and lower Zambezi River, Lake Kariba, Lake Itezhi-Tezhi and the Kafue River and flats. The most prevalent fish species in the Province are *Tilapia rendalli* (Red Breasted Bream); *Oreochromis andersonii* (Three Spotted Bream); *Oreochromis macrochir* (Green Headed Bream); *Limnothrisa miodon* (Kapenta) and *Alestes lateralis* (Chitaka) [3]. Fish bred in fisheries are the Bream and *Oreochromis niloticus* as is indicated in *Table 8.41* below.

Table 8.41 Fish Production Estimates in Metric Tonnes (all species)

Fishing Area	2000	2001	2002	2003	2004	2005	2006	2007
Kafue	6,131	6,437	6,437	6,100	6,228	6,062	5,539	6,763
Kariba	8,863	9,306	9,306	8,818	9,003	8,768	8,008	9,776
Lower Zambezi	588	617	617	585	597	581	531	649
Itezhitezhi	2,221	2,332	2,332	2,210	2,256	2,196	2,007	2,450
Total	**17,803**	**18,692**	**18,692**	**17,713**	**18,084**	**17,607**	**16,085**	**19,638**
Kapenta Fishing								
	9,176	5,666	4,416	7,481	6,574	6,251	7,659	9,476

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Districts and Social Study Area

The economies of the **Siavonga** and **Kariba Districts,** comprises of fishing including (agro-fisheries, subsistence and commercial); tourism (including safaris); agriculture and businesses. The majority of the businesses (excluding tourism) are informal. The local informal markets sell a wide range of goods and services which includes clothing, perishables, and arts and crafts targeted at tourists visiting Lake Kariba.

Trading

Formal and informal trading occur across the Project Area; with formal trading focused mainly on tourism related activities such as safaris, boat cruises, hotels/inns and restaurants. In turn, informal trading is focused on the sale of clothing, and food items inclusive of fisheries resources.

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010
(2) Provincial Strategic Plan: Southern Province, 2008 – 2010
(3) Provincial Strategic Plan: Southern Province, 2008 – 2010

Informal trading serves as the main source of livelihoods for a large portion of the population in both Siavonga and Kariba Districts. Informal trading occurs daily in formal and informal market places in both Project Areas. The markets often consist of a mixture of types of trading structures, such as formally constructed shops or make-shift stalls comprising of tables and crates to display sale goods. Usually the type of structure is indicative of the type of goods being sold (*i.e.* traders who sell groceries often trade in formal structures while traders selling fish or vegetables, trade from temporary make-shift structures; see *Figure 8.38* below.

Figure 8.38 Some Traders in Siavonga, Zambia

Source: Janet Mkhabela / Date: 25 September 2014/ Location: Siavonga Market

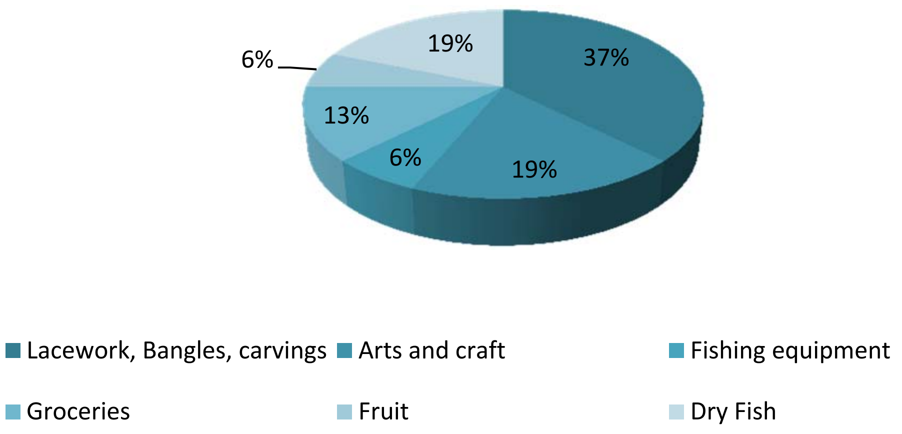
Figure 8.39 Some Traders in Kairiba, Zimbabwe

Source: Janet Mkhabela / Date: 25 September 2014/ Location: Kariba Market

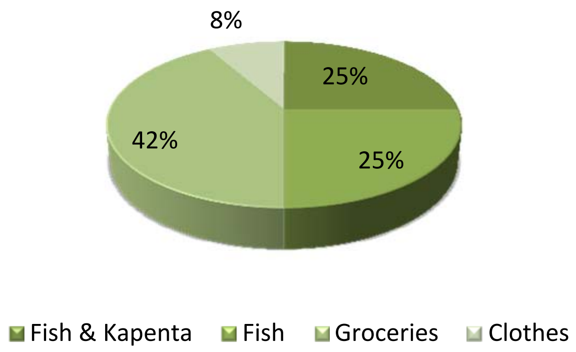
Traders in government designated trading areas must have a trading license which is issued by the local government. Trading license is renewable and payable on a monthly basis. Informal traders in the Kariba District must pay a rate of five dollars per stall monthly.

Amongst traders interviewed in Mahombekombe and Kariba Heights, approximately 37 percent sold lacework, bangles and carvings; followed by those that sold arts and crafts (at 19 percent) and dried fish (mainly kapenta, also at 19 percent) (refer to *Figure 8.40*). The main fish sellers in Mahombekombe were the fishers (this is not a common phenomenon since in other African countries, only women usually sell fish); whereas arts and crafts and other accessories were being sold mainly by women followed by 24 percent that sell groceries; while 21 percent sell accessories such as bangles, earrings and key chains; and 17 percent are fish traders consisting of a mixture of men and women.

Figure 8.40 Items Commonly Sold at Local Markets in the Social Study Area



Kariba – above

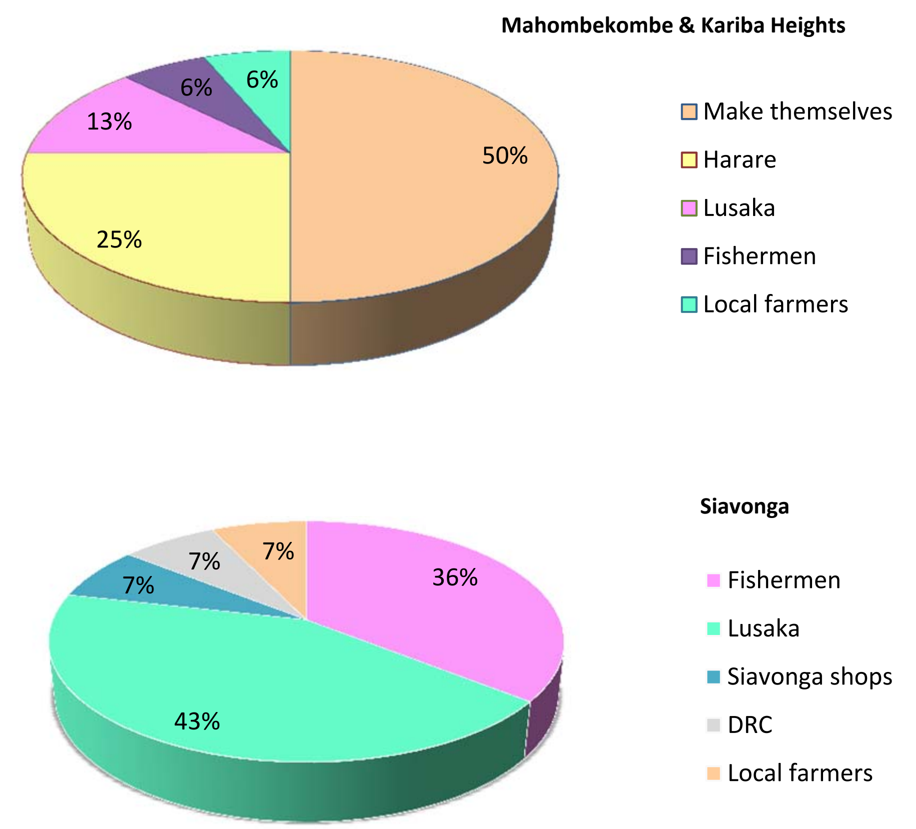


Siavonga - above

In Siavonga, the majority of the interviewees traded groceries at 42 percent, followed by those who sold fish (bream and others) and kapenta at 25 percent respectively; see *Figure 8.40.*

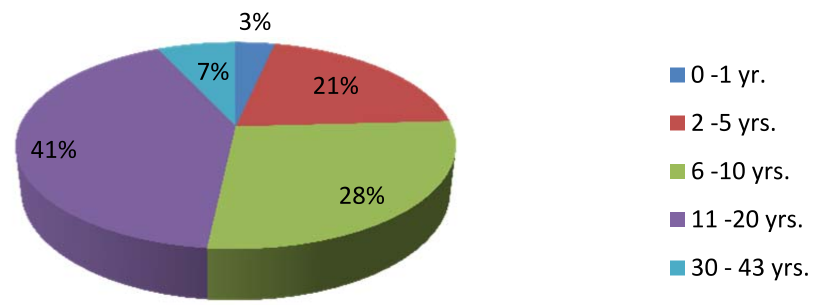
The majority of arts and craft traders reported that they produce their own items; while others purchased items in Harare. Grocery store owners, the majority of clothes sellers and vegetable and fruit traders, purchase the majority of their goods in the large cities *i.e.* Harare and Lusaka. One of the clothes' sellers reported that he often purchases special clothing items from the Democratic Republic of the Congo (DRC). . This is illustrated in *Figure 8.41* below.

Figure 8.41 Source of Traded Items



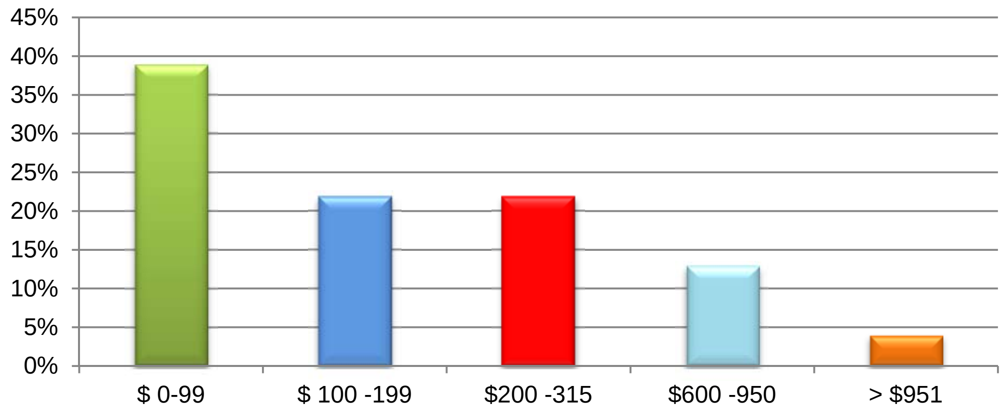
The majority (41 percent) of the traders interviewed have been trading for at least the past eleven to 20 years. Two of them have been trading for over 30 and 43 years, respectively. Only one respondent has been trading for less than a year. This is illustrated in *Figure 8.42* below.

Figure 8.42 Number of Years as Trading



The income generated from informal trading activities varies greatly, depending on the type of trading activity. For example, in Siavonga Town fruit and vegetable trader can earn up to eight dollars a month. Fishermen sometimes earn nothing in certain months as they are catching and processing fish around the small islands across Lake Kariba. People who sell and fix fishing equipment can earn up to USD 4,000 per month in peak-season. Those that sell arts and crafts can earn as little as USD 40 per month during the off-season; but as much as USD 150 to USD 400 during the peak tourist season. The monthly income patterns of traders are presented in broad categories in *Figure 8.43* below. The broad categorisation is needed due to the disparities between categories of data linked to the limited sample size.

Figure 8.43 Monthly Income of Traders



<u>*Fishing Activities*</u>

Fishing occurs on various scales across Lake Kariba, *i.e. at an* industrial or commercial scale or at an artisanal and small scale. The types of fishing that occurs on Lake Kariba include *kapenta* (offshore), gillnet fish (inshore) and limited numbers of crayfish. Commercial and artisanal fishing is discussed in more detail below.

<u>Industrial and Commercial Fishing</u>

The industrial and commercial fishers do not only fish in Lake Kariba. Some of them breed their own fish such as predominantly *tilapia*. One of the most notable commercial fisheries' companies operating from both countries is Lake Harvest Aquaculture. Lake Harvest breed, catch, process and sell its fish to the packaging companies in Harare and Lusaka for on-processing and resale to the public. The Lake Harvest fish is fed special food which has not been modified genetically. Only mature fish are harvested. The feed is imported from Mauritius and it takes between six to eight months for delivery. The delivery timeframes of the feed is one of Lake Harvest's major commercial challenges [1].

Lake Harvest breeds the fish in floating cages close to islands on the Lake. They employ people from the Siavonga and Kariba Districts. One of the managers reported that Lake Harvest Zambia harvests an estimated 65 tonnes

(1) Pers. Comms, Sept/Oct 2014

of fish per week. The company employs local people of both sexes and provides them with the necessary training to do their work such as diving lessons.

In Siavonga District, the Siavonga Kapenta Industries Limited (S.K.I.) is one of the main kapenta fishing enterprises. The commercial kapenta fishers tend to fish at night when they use high powered lights to attract the kapenta into large "dip nets" suspended just below the water surface.

Artisanal Fishers

The artisanal fishers comprise of local men and incoming participants who moved into the area for this purpose. In both Districts, artisanal fishers must obtain a fishing license from the local government. Although the activities of artisanal fishers are regulated, their knowledge of fishing laws and regulations seemed very limited upon closer questioning. They reported that the fisheries departments gave them instructions on when to fish or not to fish and how much they should pay for their licenses.

- Kapenta Fishing:

Kapenta (*orLimnothrissa miodon*) was introduced into Lake Kariba in the 1970's as a potential source of protein and since then their numbers have grown significantly [(1)]. Currently (2014) it is one of the two countries' major sources of refrigeration-free protein foods, see *Figure 8.44*.

Figure 8.44 A Typical Kapenta Fishing Boat and Kapenta Packaged for Sale

Source: Janet Mkhabela / Date: 25 September 2014/ Location and Coordinates: Unknown

The surveyed kapenta fishers in Mahombekombe reported that they only do kapenta fishing. The fishers, fish daily from the period just after dusk to just before dawn except for the days when there is a full moon. Then they do not fish the reason being that the local legend states that the light from the moon frightens the fish away resulting in a reduced catch.

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(1) http://www.siavonga-zambia.com/kapenta-fishing/siavonga-kapenta-industries.html

According to the information provided by the fishers, the kapenta are attracted to the fishing rig by surface lights. Underwater lights at depths of as 20 to 40 m below the surface attract the kapenta to concentrate at the mouth of the net. The surface lights are turned off after several hours and the net hoisted to the surface to harvest the kapenta.

During a good season an estimated 100 kg of kapenta are caught daily which translates to six tonnes per month. During a bad season, the fishers may harvest as little as 30 to 50 kg and only about one tonne per month.

The processing of the fish occurs onshore. The kapenta is sun dried on stilted racks and then packaged. Packaging is into five kilogram bags which are sold for USD 5 per five kilograms during peak-season. During the off-season, the price increases to USD 6 per five kilograms. The price of kapenta is not regulated so fishers make a joint decision as to when prices should be increased or decreased.

Interviews with the kapenta fishers (in two FGDs of 8 and 9 individuals in Mahombekombe) yielded that the fishers do not own the boats and other fishing equipment or the land on which they operate. They lease the equipment and land from local people. The fishers pay a monthly rental for the use. In addition to the rental amount they are responsible for maintaining the equipment and for refuelling the boats. Transporting of the kapenta to Harare is done with public transport specifically a company by name "Swift Transportation". They are a courier service and charges per kilogram transported. Other fishers use local busses to Harare and pay about USD 3 per 50 kg bag of kapenta; see *Figure 8.45.*

Figure 8.45 Kapenta Drying out in the Sun in Mahombekombe

Source: Janet Mkhabela / Date: 29 September 2014/ Location: Mahombekombe

- Gillnet Fishing:

The fishers interviewed in Siavonga Town reported that they only undertake gillnet fishing and the fish targeted are bream, bottle fish, tiger fish, and babel fish; see *Table 8.42*.

Table 8.42 Percentage breakdown of Fish Type Caught by Gillnet Fishers

Fish Type	Percentage
Bream	50%
Bottlefish	23%
Tigerfish	21%
Barbelfish	6%

The majority of the fishers reported that they fish in sub-basin four and sometimes in sub-basins one and five, respectively. Gillnet fishing is supposed to be undertaken for 20 days a month as per the ruling of the fisheries department; but some of the fishers reported that they fish daily. There are two times of the day that gillnet fishing occurs according to the fishers; some start fishing from four to six in the morning while others reported that they fish from seven in the evening until late at night.

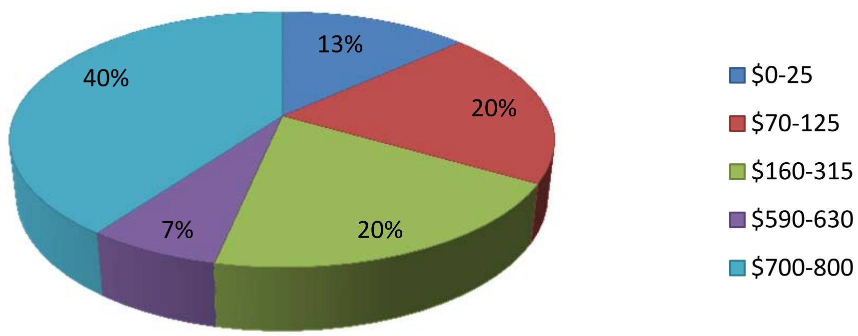
As stated previously, unlike in other African countries where the fish is done by men and the women process the fish; in Siavonga the fishers (who are men) process their own fish (clean and dry /or smoke it). Some fishers tend to migrate to some of the small islands found on the lake to do their fishing. When on the islands they catch and process the fish (*i.e.,* clean and dry it) in preparation for to sell it on their return. The fishers either sell the processed fish to the women or sell it themselves during the ten days that they are not allowed to fish; see *Figure 8.46* fishers returning from fishing.

Figure 8.46 Fishers Returning from the Fishing Islands

Source: Janet Mkhabela / Date: 24 September 2014/ Location: Unknown

According to the fishers (both kapenta and gillnet), the personal sell of fish is the most profitable compared to the fishing because when they are on the islands they generate no income. Based on the survey results the kapenta fishers make more money ($700 to $800/ month) than the gillnet fishers ($25 to $630/ month). The cause for the disparity is unclear it could be based on the sale prices of different fish or the varying catch sizes or other reasons not explained. *Figure 8.47* presents the income generated by fishers in broad income groups which have been influenced by the small survey sample.

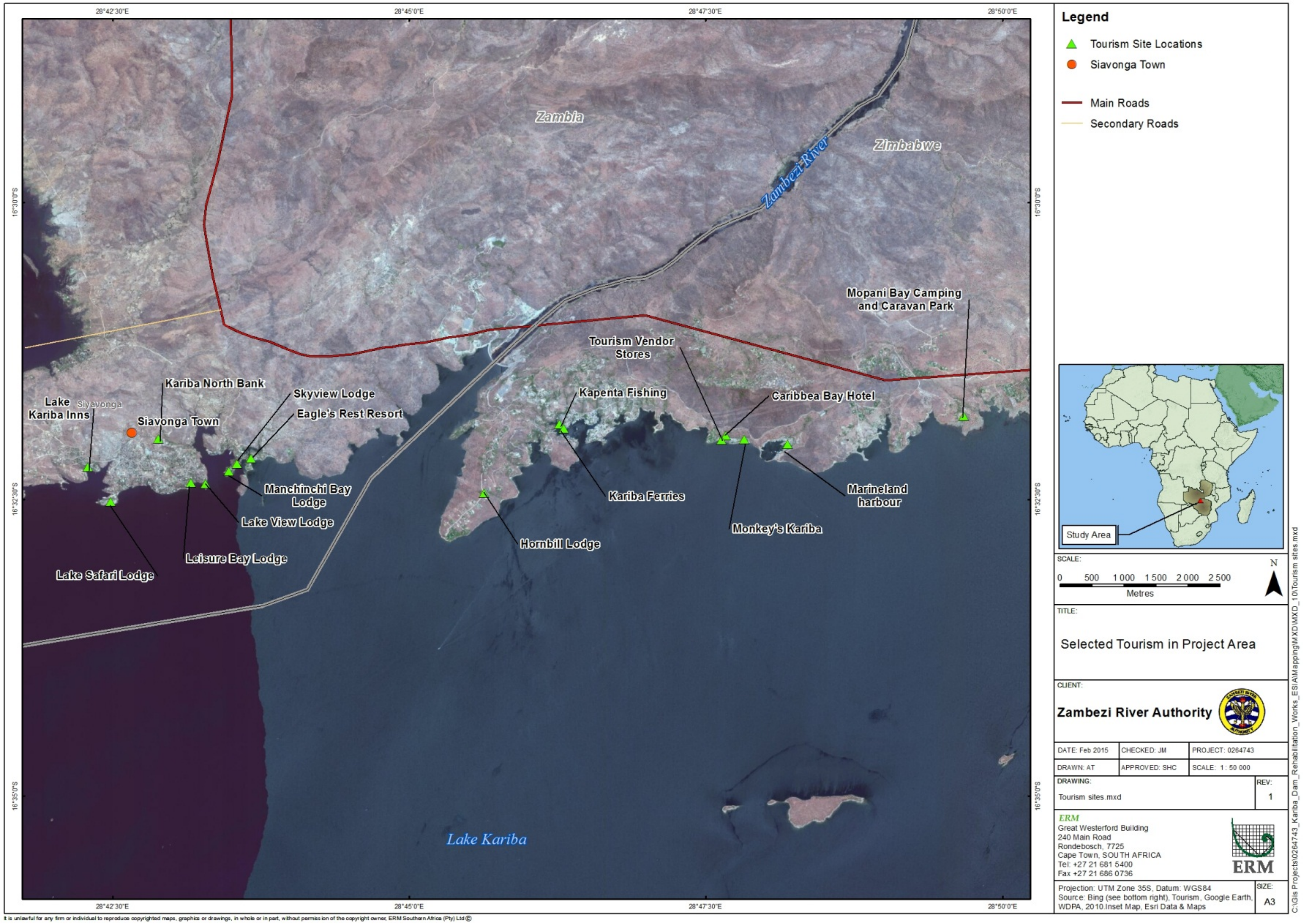
Figure 8.47 Monthly Income Derived from Kapenta and Gillnet Fishing



<u>*Tourism Activities*</u>

Tourism in both Kariba and Siavonga Districts forms an important part of the economy and similarly to the fisheries industry, tourism in the area is driven by the presence of Lake Kariba. Another tourism stimulator in the area are the multiple protected areas found in close proximity to lake (especially on the Zimbabwean side of the boarder), as indicated in *Figure 8.48*.

Figure 8.48 Selected Tourism in Project Area



Tourism in Kariba District

According to the Zimbabwean Tourism Agency (ZTA); there are currently more than 60 tourism operators registered on their database. These include hotels, lodges, tour operators and safaris, as well as speed boats and houseboats. The most popular of tourism operators are indicated in *Table 8.43* below.

Table 8.43 Some Tourism Operators in Kariba District

Type of Tourism	Tourism Operator
Hotels	Caribbea Bay Hotel Cutty Sark Hotel
Lodges	Dzimbahwe UMzimkhulu
Safaris	Natureways Mystic Tours
Speed boats and Houseboats	Marineland Zambezi Trader

All tourism operators are expected to register their businesses with the local government and pay registration and operation fees depending on the type of activities undertaken; see *Table 8.44* which indicates the amounts paid by the different operators.

Table 8.44 Tourism Operators Licence Fees in Kariba District

Tourism Operations	Registration Fees
Boats (ferries, speed and house boats)	$350
Safari	$500
Hunting	$1,000
Annual Licence Fees (Est)	$ 300

According to the ZTA, the majority of tourists who visit the area are domestic including government officials (mainly for conferences). There are limited numbers of foreign tourists in the area; the majority comes from Europe and South Africa. Long weekends, such as the Easter and school holidays as well as the festive season bring the most tourists in the area. The majority of which are domestic returners (who reside in other countries). Major events that attraction high numbers of visitors include the tiger fish tournament which is held annually from the 21st to 24th of October; and the half marathon that is held sometime in August annually. These events attract international visitors to the area; see *Figure 8.49*.

Figure 8.49 Marineland in Zimbabwe

Source: Janet Mkhabela / Date: 29 September 2014/ Coordinate: 16^0 32′ 00.81″ S; 28^0 48′ 11.01″ E

<u>Tourism in Siavonga District</u>

Similarly to the Kariba District, Siavonga District has a well-developed tourism industry propelled by the presence of Lake Kariba. The industry comprise of hotels, lodges, conference centres, boating, fishing, sunset cruises, canoeing, water sports, bird watching, cultural village tours, visits to the dam wall and power station [(1)]. Most of the larger hotels/ or lodges focus mainly on hosting conferences in addition to general tourism, while the smaller hotels/ or lodges and resorts focus specifically on tourism and provide a wide variety of tours and other activities [(2)]. In addition, there are one-to- three days canoe safaris and/or river rafting on the Lower Zambezi River as well as overnight in the houseboat charters on the Lake from one-to-ten days cruises.

Unlike the Zimbabwean side of the boarder, there are no protected areas close to the lake on the Zambian side. There are some hippos and crocodiles which are frequently seen on the lake shores. However, there is a variety of birds that have been seen in the area; these include the African fish eagle, *bateleur* eagle, harrier hawk and martial eagle, the sacred ibis, saddle-billed stork, malachite kingfisher and the lilac breasted roller, etc. [(3)].

<u>Subsistence Farming</u>

Both Districts (Kariba and Siavonga) are situated in provinces known for intensive agricultural activities (commercial and subsistence). However, the locals do not undertake any extensive agricultural activities in the area. A limited number of households (within five kilometre of the dam wall (in Zambia) keep livestock; even so, they struggle to access the water for the livestock especially in the dry season.

Furthermore, in Kariba and Siavonga, to be slightly higher numbers of in-migrants, who moved to the areas in search of employment and business

(1) http://www.zambiatourism.com/
(2) http://www.zambiatourism.com/
(3) http://www.zambiatourism.com/

opportunities, as such they do not own land but rent houses and rooms in the local areas. Even those who sell fruits and vegetables in both Kariba and Siavonga travel to Harare and Lusaka, respectively, to procure these.

8.3.9 Employment Levels

Zimbabwe had a higher labour force compared to that of Zambia 87 and 75 percent respectively (1). In both countries the labour force participation by males was high than that of females; which is a typical trend amongst African countries. Furthermore, the labour force participation is higher in both countries amongst the rural dwellers at 91 and 84 percent respectively in the rural areas and 84 and 66 percent in the urban areas. The data also shows a slightly higher employment rate in rural areas than in urban areas (81 and 66 percent respectively). This is attributed to subsistence and small scale farming being considered employment as farmers earn their livelihoods from the sale of their crops to Government (specifically in Zambia), private agencies, commercially as well as local markets; see *Table 8.45* below.

Table 8.45 National Labour force Survey in Zimbabwe and Zambia

Labour force Indicator	Zimbabwe in %	Zambia in %
Size of the Labour force	87	75
Overall Participation of the Labour Force		
Female	85	69
Male	89	80
Labour force Participation – Rural Areas	91	81
Labour force Participation – Urban Areas	84	66

Source: Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

The agricultural sector is the largest employer in both countries (66 percent - Zimbabwe and 56 percent- Zambia); the agricultural sector was said to employ the majority of the rural population in both countries (2). This can be attributed to the majority of the population of both countries residing in rural areas than urban area.

The urban population of Zambia is employed in the trade, wholesale and retail distribution sector employs 24.5 percent; whilst the urban population of Zimbabwe is involved in the elementary occupations account for 11 percent, service and sales workers 10.5 percent (3). Unemployment is low in both countries at 7.9 and 10.5 percent, respectively. This can be attributed to the economically active population's engagement in agricultural activities; see *Table 8.46*.

(1) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011
(2) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011
(3) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

Table 8.46 Employment Status of the Population: Zimbabwe and Zambia

Indicator	Zambia in %	Zimbabwe in %
Informal Employment	88.7	84
Formal Employment	11.3	11
Unclassified	-	5
Employed	92.1	89.3
Unemployed	7.9	10.5

Source: Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

Provinces

Mashonaland West Province had a higher labour force participation compared to the Southern Province, 88.4 and 76.4 percent respectively. Similarly to the national trends, the male participation in the employment was high than that of their female counterparts (Southern Province -male participation rate (81.1 percent) than female (71.8 percent) [(1)]); While in Mashonaland male participation rate was90.8 percent) and female (86.2 percent) [(2)].

In both Provinces, the agricultural sector serves as the main employer; employing 58 percent of the labour force (in the Southern Province- and 54.8 percent in Mashonaland West. The unemployment rate in the Southern Province was lower than that of Mashonaland West at 4.8 percent [(3)], (which is lower than that of the national level of 7.9 percent. Unemployment rate in Mashonaland West is approximately 11 percent [(4)], which is in line with the national rate of 10.7 percent.

Districts

The unemployment rate in Kariba is 22.28 percent, while in Kariba Rural 22.51 percent [(5)], which is almost double that of the National and Provincial unemployment rates. The primary occupation in Kariba Rural is agriculture, which is undertaken by 72.1 percent of the economically active population, followed by services, which employs 9.6 percent [(6)]. In contrast, only 17.9 percent of the population in Kariba participation in agriculture, and the services sector is the primary occupation, undertaken by 28.7 percent [(7)]. Mining and construction and transport are also prominent occupations in Kariba with 6.2 percent and 6.9 percent of the population engaged in these activities respectively [(8)]. This disparity can be attributed to the largely urban nature of the Kariba District.

(1) Preliminary Results of the 2012 Labour-force Survey (May 2013)
(2) Zimbabwe Labour Force Survey 2011
(3) Chapter 6 Economic Characteristics
(4) Zimbabwe National Census Report 2012
(5) Mashonaland West Province Report
(6) Mashonaland West Province Report
(7) Mashonaland West Province Report
(8)Mashonaland West Province Report

There is statistical data on employment for Siavonga District. The District's IDP report states that formal employment is provided by the fishing industry, tourism (lodges), central government, and energy mainly hydro-power generation (ZESCO). In turn the informal sector employs the most people especially, fisheries and trade.

The employment levels within the formal sector of employment are limited to government, parastatals and tourism sectors in both Kariba and Siavonga. However, the informal sector of the economy employs significant number of people in the area who engage in trading as well as artisanal fishing.

8.3.10 *Public Infrastructure and Services*

This *Section* describes access to public infrastructure and services in the countries, provinces, districts and SSA.

Water and Sanitation

Access to improved water sources in Zambia was lower at 49 percent, compared to that of Zimbabwe where 79 percent have access to an improved source of water. The population in urban areas in both countries have better access to improved, with Zimbabwe at 95 percent in urban areas and 70 percent in rural areas; while in Zambia 83 percent urban and 19 percent in the rural areas [(1)].

In Zambia more than half of the households (56 percent) draw their water from an unimproved source. In rural areas of Zimbabwe, tube-wells/ or boreholes are the main source of drinking water (37 percent), followed by protected and unprotected dug wells (21 percent and 17 percent, respectively) [(2)].

In Zambia, an estimated 36 percent use appropriate water treatment method; whilst only 22 percent in Zimbabwe treats its unimproved water before consuming. The most used method of water treatment in Zambia is chlorine, with 44 percent of households using it in urban areas [(3)]. Boiling the water prior to consumption was another method used in Zambia by the urban population at 26 percent. Both these treatment methods were used less in the rural areas at 19 and nine percent, respectively.

In turn, in Zimbabwe most households using unimproved water sources did not treat its water (78 percent); whilst nine percent of households boil their water, and 14 percent use bleach or chlorine [(4)]. The sources, type and treatment regime of water in both countries is summarised in *Table 8.47* below.

(1) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007
(2) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007
(3) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007
(4) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Table 8.47 Household Portable Water Characteristics in Zambia and Zimbabwe

Characteristic	Zimbabwe		Zambia	
Source of drinking water	**Households**	**Population**	**Households**	**Population**
Improved Source				
Piped water into dwelling/yard/plot	28.8	25.4	41	41.8
Public tap/standpipe	4.7	3.7	14	13.2
Tubewell/borehole	28.4	30.4	0	0
Protected dug well	16	16.5	12.3	12.6
Protected spring	0.7	0.7	0	0
Rainwater	0	0	0	0
Bottled water	0.1	0.1		
Non-improved source				
Unprotected dug well	12.7	13.8	55.8	55
Unprotected spring	2.4	2.6	35	34.9
Tanker truck/cart with drum	0.3	0.2	0	0
Surface water	5.8	6.4	20.7	20.1
Other source	0.1	0.2	3.3	3.2
Percentage using any improved source of drinking water	**78.7**	**76.7**	**41.1**	**41.9**
Time to obtain drinking water (round trip)				
Water on premises	42.4	39.4	22.2	23.9
Less than 30 minutes	36.1	37.1	54.3	52.7
30 minutes or longer	20.6	22.8	22.5	22.6
Don't know	0.9	0.8	1	0.8
Water treatment prior to drinking				
Boiled	8.6	8.2	15.2	16.2
Bleach/chlorine added	14.4	15.4	27.2	28.9
Strained through cloth	0.1	0.1	0.1	0.2
Ceramic, sand or other filter	0.3	0.4	0.1	0
Solar disinfection	0.1	0	0.1	0
Other	0.6	0.6	0.8	0.8
No treatment	78.1	77.6	65.1	63.2
Percentage using an appropriate treatment method	**21.5**	**22**	**34.2**	**36.1**

Sources: Zimbabwe Demographic and Health Survey (2011); and Zambia Demographic and Health Survey, 2007

Access to improved sanitation facilities is poor in Zambia especially amongst the rural population 20 percent overall and 11 percent in the rural areas [(1)]. In the urban centres, water supply and sanitation services are reticulated; however, the infrastructure in many of the towns is old and outdated. This results in the systems being overused and unable to meet demand. In Zimbabwe, an estimated 36 percent of households in Zimbabwe have improved toilet facilities that are not shared with other households [(2)]. Slightly less than half of these households have flush toilets, mainly toilets connected to a piped sewer system (13 percent).

Almost four in ten households in Zambia (39 percent) use pit latrines that are open or have no slab: 27 percent in urban areas and 45 percent in rural areas.

(1) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

(2) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Flush toilets are mainly found in urban areas and are used by 26 percent of households, compared with one percent in rural areas. Overall, 39 percent of households in Zimbabwe had no toilet facilities; with only 25 percent in Zambia [1]; see further information in *Table 8.48*below.

Table 8.48 ***Access to Sanitation Facilities in Zambia and Zimbabwe in Percentages***

Type of Facility	Zimbabwe		Zambia	
	Household	Population	Household	Population
Improved, not shared facility	30.8	37.3	20.2	23.9
Flush/pour flush to piped sewer system	1.9	13.5	6.8	8.2
Flush/pour flush to septic tank	1.2	2.3	2.5	3
Flush/pour flush to pit latrine	0.5	0.7	0.2	0.3
Ventilated improved pit (VIP) latrine/ toilet	16.4	12.6	4.6	5.2
Pit latrine with slab	10.7	8.1	6.1	7.2
Shared facility1	18.9	24.2	15.1	13.4
Flush/pour flush to piped sewer system	0.6	11.3	0	0
Flush/pour flush to septic tank	0.3	1	0.1	0.1
Flush/pour flush to pit latrine	0.1	0.7	0	0
Ventilated improved pit (VIP) latrine/	11.5	6.8	0	0
Pit latrine with slab	6.4	4.4	25.9	38.5
Non-improved facility	50.3	38.5	79.8	76.1
Flush/pour flush not to sewer/septic tank/pit latrine	0.1	0.3	0.1	0.1
Pit latrine without slab/open pit	11.5	9.3	38.5	38.5
Bucket	0	0.5	0	0
No facility/bush/field	38.6	28.3	25.2	23.5
Other	0.1	0.1	0.7	0.5

Source: Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Districts and Social Study Area

The availability of portable water in the Districts varies based on where the household is located. Households based in the urban parts of the Districts have access to pipe water inside the dwelling; while households located in the peri-urban areas have access to communal taps located within 500m of their households. However, communities in the rural areas, access water in boreholes/ or springs, communal taps (with two or more kilometres from the household). Even though some communities have access to communal water taps, the water may not be clean. For instance, in the settlement of Micho, the population complained that the water from the communal taps sometimes comes out with faecal matter in it. This is an indication that the sewage and portable water pipes run to one another at some point and both are leaking which has resulted in the contamination of the portable water.

(1) Zambia Demographic and health Survey, 2007

Similarly to access to water, access to improved sanitation is dependent on the location of the household. The urban population has access to improved sanitation facilities while the peri-urban communities have a mixture of improved and unimproved sanitation. The rural population uses pit latrines due to a lack of water in the dwelling and required sewage system.

All government offices have access to pipe water and flush toilet facilities in both Kariba and Siavonga.

Transportation

Road Networks

The major urban centres in Zambia are connected via road. The main trunk roads include the Great North Road, which runs from Lusaka through the Central, Northern and Muchinga Provinces, up to the Tanzanian border town of Tunduma. The Great East Road runs from Lusaka through the Eastern Province up to the Malawian border. Other trunk roads include the Lusaka-Livingstone road and the Lusaka-Chirundu border post road. Road passenger transport is operated by private companies. The government of Zambia is currently planning to construct approximately 8,000 km of new roads across the country (1).

In turn, Zimbabwe has a fairly extensive road network, which connects the urban centres of the country to Harare. The main highways extend out from Harare to neighbouring countries Mozambique, South Africa and Zambia. The general condition of roads has deteriorated due to inadequate funding for regular maintenance (2).

Railway Networks

Zambia's railway infrastructure includes the TAZARA, which runs from Kapiri Mposhi and traverses through Mkushi and Serenje, terminating at the port city of Dar-es-Salaam in Tanzania as well the Railway systems of Zambia. The national railways are operated by Railway Systems of Zambia stretch from Livingstone in the Southern Province through Lusaka, to the Copperbelt town of Kitwe. Both the TAZARA and Railway Systems of Zambia operate freight and passenger trains.

Zimbabwe has a rail network that covers an estimated 3,077 km; of which 318 km is belonging to Bulawayo-Beitbridge Railway (Private) Limited. Of the 2,759km maintained by the public sector through the National Railways of Zimbabwe, only 313km (Dabuka to Harare) was originally electrified, but it has been vandalized and is in a state of disrepair. This, coupled with reduced economic activity has negatively impacted the ability to utilise the railway network at its full capacity (3).

(1) Radio broadcast in February 2013
(2) Zimbabwe National Development Plan 2011 - 2015
(3) Zimbabwe National Development Plan 2011 - 2015

Provinces and Districts

The A1 highway is paved and traverses through Mashonaland West Province, from Harare to the Zimbabwe-Zambia border. Further there are two secondary unpaved roads which run in an east-west direction across the Province. The A1 highway crosses the border into Zambia where it becomes the T2 highway and then traverses the Southern Province. In addition, the T1 highway also traverses the Southern Province, and connects Livingston to Lusaka. The T1 further traverses through the Kariba and Siavonga districts. The secondary roads in the districts are mostly paved and though some have potholes.

Modes of Transportation

The commonly used modes of transport in both countries,' are bicycles, animal drawn carts and wheelbarrows, specifically in Zimbabwe. This is reflected in *Table 8.49* below.

In Zambia, an estimated 40 percent of the population uses bicycles as their main mode of transport, meaning that one in four people owns a bicycle. In Zimbabwe, a mixture of transport modes is used. The wheelbarrow as a mode of transport is used by 31 percent of people, followed by bicycles at 22 percent, animal drawn carts at 19 percent and cars and trucks at three percent.

Table 8.49 Modes of Transportation

Means of Transport	Zimbabwe			Zambia		
	Urban	Rural	Total	Urban	Rural	Total
Bicycle	20.7	23.5	22.6	27.1	47.8	40.6
Animal drawn cart	9.6	23.9	19	0.5	5.7	3.9
Motorcycle/scooter	1.6	0.9	1.1	0.4	0.4	0.4
Car/truck	15.6	3.1	7.3	6.5	0.6	2.7
Boat with a motor	0.6	0.1	0.3	0.2	0.1	0.1
Wheelbarrow	26.5	33.5	31.1	-	-	-
Tractor	1	0.7	0.8	-	-	-
Banana boat	-	-	-	0.3	3.8	2.6

Source: Zimbabwe National Census Report, 2012; Zambia Vision 2030.

8.3.11 Energy

In Zambia, access to electricity is generally limited. According to the Sixth National Development Plan, access to electricity increased from 20 percent of the population in 2005 to 22 percent of the population in 2009.

In 2010, only 3.5 percent of people in rural areas had access to electricity, compared to 48 percent in urban areas. This is largely due to the slow implementation pace of the Rural Electrification Programme. In recent years the country has been experiencing power shortages due to an increased demand by industry and mines, while supply has remained the same. Mining operations are the primary user of energy in the country [1]. Firewood is the most common source of cooking fuel due to the poor rural electrification position. The high reliance on firewood and charcoal has resulted in increased deforestation across the country.

Hydroelectric power plants are responsible for 99 percent of electricity production in the country with the major sources being Kafue Gorge, Kariba North Bank and Victoria Falls power stations, which produce 900 MW, 600 MW and 108 MW respectively. Other small scale hydropower sources are the Mulungushi (28.5 MW) and Lunsemfwa (18 MW) hydropower plants. The country's hydropower resource potential is estimated at 6,000 MW that could potentially be harnessed to promote economic growth. Installed capacity is approximately 1,788 MW [2].

Zimbabwe's commercial sector is well supplied with electricity, however, wood fuel remains the primary source of energy for domestic use [3]. Across the country, approximately 41 percent of households have access to electricity, leaving over half of the country without access to electricity [4]. This explains the high use of wood fuel as a primary energy source as illustrated in *Table 8.50* following.

Table 8.50 ***Access to Energy and Energy Sources***

	Zimbabwe			Zambia		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Access to electricity	83.2	13.3	36.9	47.8	3	18.5
No access to electricity	16.8	86.7	63.1	52.2	97	81.5
Cooking Fuel						
Electricity	73.2	5.6	28.4	38.5	1.8	14.5
LPG/natural gas/biogas	0.4	0	0.2	0	0	0
Kerosene/paraffin	5.2	0.2	1.9	0	0	0
Jelly	0.1	0	0	0	0	0
Coal/lignite	0	0	0	0.6	0	0.2
Charcoal	0.2	0.1	0.1	53.1	10.2	25
Wood	19.8	93.9	68.9	7.5	87.8	60
Straw/shrubs/grass	0	0	0	0	0.1	0.1
Other	0.9	0	0.3	0	0	0
None	0.1	0	0	0.2	0.1	0.1

Source: Zimbabwe National Census Report, 2012; Zambia Vision 2030.

Provinces

In Mashonaland West, 43 percent of households have access to electricity. The remaining households rely on charcoal, fuel wood, candles, solar and other alternative sources of energy. Similarly to Mashonaland West, the majority of the population in the Southern Province has no access to electricity. This is

(1) Ministry of Energy and Water Development the Study for Power System Development Master Plan in Zambia Final Report (Summary), 2010

(2) Zambia Vision 2030

(3) Zimbabwe National Development Plan 2011 - 2015

(4) Zimbabwe National Census Report, 2012

despite the province being connected to the national grid and being an electricity producer. The rural and urban poor depend largely on natural resources. Forests provide an important source of energy with 69.3 percent of the population rely on firewood and only 17.8 percent on charcoal for cooking. This has exacerbated the over-exploitation of forest resources in the province.

Districts

There is a large disparity between urban and rural households' access to electricity in the Kariba District. Eighty eight percent of households in Kariba have access to electricity while the remaining 12 percent relies on natural resources such as gas, paraffin and solar power for energy. This is pattern seen across the country, as urban areas typically have better access to electricity than rural areas.

Even though the population of Siavonga reside close to a power station, household connections to the national grid are limited to 18 percent only. The remaining 82 percent of the households use other sources of energy for lighting and cooking; with charcoal being the main source of energy for cooking and solar and battery-fuelled camping-lights being used for lighting purposes [(1)].

Similarly to the provincial and district levels; the Study Area has a lack of access to electricity and rely on charcoal, fuel wood, solar and other alternative sources of energy for lighting and cooking. Issues of affordability also play an important part in the lack of access to electricity.

8.3.12 Cultural Heritage

While there are no cultural heritage or archaeological monuments or remains, or grave sites in the Social Project Area of influence, the Kariba Dam does hold cultural heritage significance in the region.

Construction of the Kariba Dam

Currently at the Kariba Dam, conservation policies protect cultural heritage. The construction of the Kariba Dam and inundation of the valley represents a culturally significant event in the region. In 1958, engineers created the lake by damming the Zambezi River. Over the next five years, the reservoir flooded 5,580 square km, displacing 57,000 Tonga farmers and destroying habitat. In response to this, conservation-minded writers and photographers expressed shock and alarm (McDermott Hughes, 2006).

Gradually, the artificial lake has been accepted by most. One perspective is that the lake answered a deep European longing for water in inland, in semi-arid Africa, where Kariba Dam did the work of glaciers, carving intricate 'fjords' and 'lochs' in a country that previously lacked any shoreline. This perspective also holds that with the Kariba Dam, Europeans imported their

(1) Siavonga IDP, undated

hydrological heritage. Kariba Dam can be seen as an example of what has been until recently a hidden tension in ecological conservation: the tolerance of history and cultural heritage. It is argued that until now, Euro-Zimbabwean heritage has benefited disproportionately from that tolerance (McDermott Hughes, 2006).

Nyaminyami (Shingai River God) or Zambezi Snake Spirit

Shingai Musasiwa, also known as the Nyaminyami (Shingai River God) or Zambezi Snake spirit, is one of the most important gods of the Tonga people. Nyami Nyami is believed to protect the Tonga people, while also giving sustenance in difficult times. The Nyami Nyami is variously described as having the body of a snake and the head of a fish, a whirlpool or a river dragon, the Nyami Nyami is seen as the god of the Zambezi Valley and the river before the creation of the Kariba Dam. The Nyami Nyami is often depicted as a snake-like being or dragon-like creature with a head of a fish. Carvings of the Nyami Nyami can be found as pendants on jewelry, usually carved out of wood, stone or bone, occasionally ivory, silver or gold both as a fashion accessory and as a good luck charm. It is the traditional role of tribal elders and spirit mediums to intercede on behalf the inhabitants of the Zambezi River valley when Nyami Nyami is angered (Zambezi.com, 2007).

The Nyami Nyami is said to reside in the Zambezi River and control the life in and on the river. Furthermore, the spirits of Nyami Nyami and his wife residing in the Kariba Gorge are god and goddess of the underworld. Some Tonga people hold the belief that the building of the Kariba Dam deeply offended the Nyami Nyami, separating him from his wife. The regular flooding and deaths during the Kariba Dam's construction were attributed to his wrath. Some Tonga believe that once the Kariba Dam was completed that the Nyami Nyami withdrew from the world of men (Zambezi.com, 2007).

KEY FINDINGS – Social:

- The Tourism, trading and fishing are the primary sources of income and subsistence for population.
- Formal employment is mainly provided by the tourism sector, government services and commercial fishing companies.
- Due to a shortage of water for agricultural use, a limited number of people engage in agricultural activities i.e., livestock farming in Micho only.
- The SSA is highly accessible due to the paved public roads and the availability of public transportation.
- Trading of goods and other household items is undertaken daily.
- The population is literate, with a significant number of people having completed primary and some secondary schooling.
- Access to electricity is limited amongst households, because of lack of affordability.
- In settlements such as Micho there is a significant lack of sanitation facilities and where they exist the sewage system is inadequate.
- High levels of water borne illnesses such as malaria (SSA falls within a malaria region) and diarrhoea (unclear reasons).
- All communities have adequate access to primary health care services.

9 IMPACT ASSESSMENT AND MITIGATION

The predicted impacts to the physical, biophysical and social environment as a result of the proposed Kariba Dam Rehabilitation Project are described in this *Chapter*. This *Chapter* also details potential mitigation measures in order to avoid, minimise, reduce, remedy or compensate for potentially negative impacts, and enhance potential benefits of the proposed Project. Furthermore this *Chapter* provides a prediction of the residual impact that will remain, assuming that the appropriate mitigation measures are implemented. The development of mitigation/management measures and the management of residual impacts are fully described in the Environmental and Social Management Plan (ESMP) (refer to *Part III of this ESIA*). The methodology to identify and assess impacts is explained in *Chapter 5*.

This *Chapter* assesses the more significant impacts associated with the proposed Project. As part of the Scoping Phase, a preliminary and qualitative screening assessment of potential environmental and social impacts associated with the Project was undertaken. This screening assessment is an important part of the overall ESIA as it ensures that the ESIA focuses on those impacts that are more significant. With respect to this, a preliminary, qualitative screening assessment of environmental and social impacts was undertaken as part of the Scoping phase. The following impacts were screened out during scoping phase and have not been considered in this *Chapter* –

- Noise impacts;
- Impacts due to dust (air quality impacts);
- Loss to archaeological, palaeontology and cultural heritage;
- Visual and landscape impacts; and
- Impact of waste generation.

Please Note – *although these impacts were screened out during the Scoping Phase mitigation commitments for such impacts have been included in the ESMP.*

The predicted impacts on the physical, biophysical and social environment are discussed as follows:

- **Physical Environment**:
  - Impacts on Hydrology
  - Impacts on Water Quality
  - Impacts on Erosion and Sedimentation
- **Biophysical Environment:**
  - Impacts on the Aquatic Environment
  - Impacts on Terrestrial Habitat
  - Impacts on Terrestrial Species of Conservation Concern

- Impacts on Protected Areas

- **Social Environment:**

    - Impacts on Tourism
    - Impact on Fisheries-Based Livelihoods
    - Creation of Employment Opportunities
    - Procurement of Goods and Services
    - Impacts related to Possible Unfair and Unsafe Working Conditions
    - Increased Incidence of Sexually Transmitted Infections (STIs) including HIV/AIDS
    - Increased Risk of Road Traffic Accidents

Moreover, this *Section 9.4* considers impacts associated with Dam Safety.

9.1 IMPACTS ON THE PHYSICAL ENVIRONMENT

9.1.1 Impacts on Hydrology

Description of Baseline Environment

The existing flows reflect a large digression from reference flow conditions, and remain the major driver of the altered habitat and cover units for instream aquatic communities noted. Similarly, channel widening has laterally impacted on the riparian zones, downslope floodplains and swamp areas, causing a loss of these habitats due to loss of inundation in these zones.

Proposed Project Activities

The area that will be affected by the proposed plunge pool reshaping is located between the dam structure and power station outflows. The main activities posing a risk of additional hydrological alterations are: (i) the proposed spillage / non-spillage periods (ii) the decanting of water accumulated within the plunge pool and (iii) the crossing of smaller non-perennial systems associated with linear infrastructure. Loss of downstream flows due to the possible spilling / non-spilling requirements poses the greatest risk to ecological flow requirements. Dewatering volumes linked to the plunge pool is marginal compared to existing turbine discharge and is unlikely to have any impact on the hydrology of the system. The construction of new or upgrading of existing linear infrastructure (i.e. access roads) will require permanent or temporary crossings for a number of smaller non-perennial systems. The construction activities associated with these crossing structures often induce hydrological impacts on the receiving environment.

Sensitive Receptors

The residual sensitivities of the existing instream aquatic community to possible flow alteration is moderate to low, although a small portion of the baseline community have specific flow requirements. Of the sampled fish community one species (*Chiloglanis neumannii*) reflects intolerance to alteration in hydrology, while an additional three sampled fish (*Labeo congoro, L. cylindricus and Micralestes acutidens*) indicate a moderate intolerance to no flow conditions. The remainder of the fish and aquatic invertebrates sampled reflect a tolerance to no flow conditions. The hydraulic cross section indicates a loss in marginal instream habitat, consisting of slow-deep flowing water and aquatic vegetation, at a maintenance low flow of approximately 440m^3/s, compared to the habitat availability under the measured flow during the September 2014 assessment. The entrenched nature of the gorge below the dam allows for large decreases in volume before notably affecting available habitat.

Significance of Impact (Pre-mitigation)

The rehabilitation of the dam, specifically referring to any of the three scenarios, can be considered to have little to no impact on the hydrology of the downstream river reach when compared to the present state of the system, if the hydropower releases are made throughout the project duration (as defined by the hydrology baseline in *Chapter 8*). However, there is a low probability that these releases may not be possible due to a lack of inflows to the dam after the dam water level has been lowered (i.e. if reservoir management results in a sustained non-spillage of 16 or 11 months [refer to alternative scenario 1 and 2 in *Section 6.4* of *Chapter 6* of *Part I* of this ESIA]), which would have significant negative impacts on the downstream hydrological system in terms of flow volume for downstream users and for the downstream receiving environment. Decreasing flows below the Environmental Flow Requirements (EFRs) will have a **Major Negative Impact** pre-mitigation (refer to *Table 9.1*).

Table 9.1 Rating of Impacts Related to Hydrology (Pre-Mitigation)

Type of Impact		
Indirect Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	International	Decreasing discharge volumes to below EFR will affect instream conditions between Kariba Gorge and Cahora Bassa Dam.
Duration	Short Term	Under Scenario 1 and 2 spilling and subsequent losses in turbined water will occur.
Scale	Large	Altering downstream flows will affect conditions between Kariba Dam and Cahora Bassa Dam.
Frequency	Low	Project duration and post-project re-equilibration dependant.
Likelihood	Likely	Impeding on downstream flows is more likely for reservoir management alternative scenario 1 and 2 than for alternative scenario 3.
Magnitude		
Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Medium Sensitivity		
Intolerance to alteration in hydrology reflected by *Chiloganis neumanni, and* Moderate intolerance to no flow conditions reflected by *Labeo congoro, L. cylindricus* and *Micralestes acutidens.*		

Significant Rating Before Mitigation
Major Negative Impact

Mitigation/Management Measures

The implementation of the preferred reservoir management scenario as defined in *Section 2.4.8* of *Chapter 2* of this ESIA, and the use of a cofferdam structure that can allow for spill events as, and when they are required, are the main mitigations for impacts pertaining to hydrology. Although it is recognised that any spill is likely to have a positive effect on the downstream ecology and channel processes, the risks associated with not enough discharge, for any period of time, are greater.

In the event that that turbined water releases require a decrease in discharge, the boundary condition for low flows should not be less than the maintenance low flow of 440m³/s.

The construction of linear infrastructure will also pose hydrological impacts for associated non-perennial systems. The extent of these impacts is limited and the systems are relatively small, but as a good measure the following mitigation measures are recommended:

- Non-perennial systems affected by linear infrastructure should be crossed perpendicular to banks and where feasible at the narrowest section of the watercourse.

- The alignment and placement of in-channel support structures should be perpendicular to the channel banks. This consideration is valid for both temporary and permanent crossing structures. Where in-channel supports are used, they should be parallel to stream flow. Similarly, span bridges should be placed parallel to banks. Both temporary and permanent crossing structures should allow sufficient space to accommodate flood events.

- Watercourse crossing design for linear infrastructure, in particular relating to the upgrade of the access road to the quarry, which crosses a perennial stream (Site K1), should aim to maintain natural channel processes. This might require a complete span of the watercourse. Spanning systems (particularly smaller watercourses) is preferred over in-channel support structures. An ecological sound water crossing allows hydrological and substrate continuity.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact to hydrology will be a **Negligible Negative Impact** post-mitigation (refer to *Table 9.2*).

Table 9.2 Rating of Residual Impacts Related to Hydrology (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	International	Even short periods of decrease flow releases will affect the stretch of instream habitat between Kariba Gorge and Cahora Bassa inflow.
Duration	Temporary	If flow reduction is required, adhere to the boundary conditions as set out by the EFRs.
Scale	Small	If boundary conditions, as set out by the EFRs, are met.
Frequency	Low	Project duration and post-project re-equilibration period dependant.
Likelihood	Unlikely	The likelihood of notable flow related impacts will further decrease if release volumes remain above boundary conditions.
Magnitude		
Negligible Magnitude		
Significant Rating After Mitigation		
Negligible Negative Impact		

9.1.2 Impacts on Water Quality

Description of the Baseline Environment

Water quality fell within threshold values for sustaining aquatic ecosystems. Results from both the September 2014 (low flow) and February 2015 (high flow) field assessments were consistent with the water quality data provided by the Zambezi River Authority. Water from this reach was characterised by circumneutral pH values and relatively low electrical conductivities. Conversely, water sampled within the old disused Sinohydro Quarry Site (the preferred site for the waste rock dump) reflected a high alkalinity and salt loads. This water is contaminated and should remain isolated from aquatic environments.

Proposed Project Activities

An impact on water quality is considered the most likely of the potential impacts identified. Potential sources of impacts on water quality have been identified as: (i) dewatering of the plunge pool, (ii) the installation of the cofferdam and dewatering of the associated work area, (iii) dredging of the slipway, (iv) blasting activities and (v) construction and use of associated access roads. The perceived impacts are mainly related to rehabilitation where the deterioration of water quality will most likely be attributed to increased sediment loads (e.g. earth and rock moving activities), construction material (e.g. cement), hydrocarbons (e.g. oil and diesel), solvents and other hazardous substances via accidental spillage/leakage from construction machinery and equipment. The following briefly discuss each of the potential impacts on water quality:

- The plunge pool area may become sediment laden and contaminated by sediments, solvents and other hazardous substances during rehabilitation.

The degree of contamination within the plunge pool may intensify over time as the water level drops. It is likely that sediment and silt will accumulate at the bottom of the pool.

- The installation of the upstream floating cofferdam (required for rehabilitation of the spillway) and the associated work area is perceived to have a negligible impact on water quality due to the small quantities of water that is anticipated to come into contact with the work area. The construction and installation of the downstream cofferdam (required for the rehabilitation of plunge pool) is anticipated to have a higher probability of water quality related impacts.

- The sediment that will be removed during the dredging process may be contaminated with diesel range organic pollutants and may pose a risk to downstream water quality during the dredging process.

- Blasting activities may result in elevated nitrate levels within the receiving watercourses. Nitrates are highly toxic to fish (Pommen, 1983). In addition, during the blasting activities, water may come in contact with dust and rock aggregate which may alter the water chemistry (e.g. alter pH and increase in salts).

- Due to the steep nature of the associated banks of the Zambezi River, sediment laden surface runoff has a high probability of entering the system. This runoff may also transport pollutants into the receiving watercourse during rehabilitation works.

Sensitive Receptors

The instream aquatic community reflects a medium to low sensitivity to alteration in water quality. *Chiloglanis neumanni* is the only sampled fish to reflect a high sensitivity to alteration in water quality. Although the Critically Endangered *Oreochromis mortimeri* have been sampled the conservation status of this species relate to the introduction of competing and hybridising *O. niloticus.* Similarly the diatom community reflects a moderate tolerance for nutrients and salts, while the invertebrate community mostly comprise of taxa tolerant to changes in water quality.

Additional alteration within the baseline aquatic community due to changes in water quality remains possible. The present ecological sensitivity is lower than that of the reference/historical community, thus lowering the potential severity of the driver impacts induced by the proposed activities. However, this does not mean that the existing community is immune to degradation and remains likely to respond to water pollution.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, the impact on water quality will be a **Moderate Negative Impact** pre-mitigation (refer to *Table 9.3*) on the water quality of the receiving environment. The plunge pool reshaping and spillway dredging activities will require instream actions such as dewatering, blasting and sediment removal, which are likely to result in water contamination.

Table 9.3 Rating of Impacts Related to Water Quality (Pre-Mitigation)

Type of Impact		
Direct Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	Rivers are longitudinal systems and contamination pathways.
Duration	Long term	Although the proposed construction activities are relatively short lived, some forms of possible pollution remains persistent once they have occurred.
Scale	Moderate	Reduced instream flow will concentrate pollutants.
Frequency	Moderate	Blasting, decant and spill event dependant.
Likelihood	Likely	Some form of water contamination is likely to occur owing to the nature of the proposed activities. The main impacts relate to sediment pluming, during instream and dewatering activities, and nutrient releases during blasting.
Magnitude		
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Medium Sensitivity		
The instream aquatic community reflects a medium to low sensitivity to alteration in water quality. *Chiloglanis neumanni* is the only sampled fish to reflect a high sensitivity to alteration in water quality. Although the Critically Endangered *Oreochromis mortimeri* have been sampled the conservation status of this species relate to the introduction of competing and hybridising *O. niloticus*. Similarly the diatom community reflects a moderate tolerance for nutrients and salts, while the invertebrate community mostly comprise of taxa tolerant to changes in water quality.		
Significant Rating Before Mitigation		
Moderate Negative Impact		

Mitigation/Management Measures

The following provides an overview of recommended mitigation/management measures associated with water related impacts during rehabilitation of the Kariba Dam, for all proposed activities:

- No dumping of any building rubble, soil, litter, organic matter or chemical substances should occur within watercourses. Dumping and temporary storage of the aforementioned should only occur at predetermined locations located outside of the riparian zone.

- It is likely that the water within the plunge pool will become sediment laden and possibly polluted. As dewatering takes place the water quality within the plunge pool may deteriorate further at greater depths. The dewatering systems should be designed to accommodate as much sediment trapping as possible. The total suspended solid levels downstream of the dewatering point should not vary with more than 15% that of background levels.

- Construction equipment should not be serviced or refuelled near the river or dam. In cases where there is no option but to refuel near the water, suitable preventative and responsive actions should be taken.

- A detailed course of action for accidental spills or surface water contamination should be provided for all sites where such contaminates are stored/used. This course of action should describe detailed measures to control risks related to suspended sediment and turbidity, damage to riparian vegetation and spillage of fuels and oils, cement and other foreign materials.

- Where instream rehabilitation activities take place, measures should be provided that will be used to stabilise bed and banks after completion of rehabilitation efforts.

- All active work sites should consider stormwater management. Runoff from active work sites are commonly a point source of pollution. Typical mitigation measures include the separation of clean and contaminated runoff, where contaminated runoff is isolated and treated.

- Dredging activities associated with the construction of the slipway, should aim to minimise the spatial and temporal extent of sediment disturbances. In the case that dredge sediment reflects increased concentrations of diesel range organics, this should be removed and disposed of at an area outside of the riparian zone, river, dam or any other drainage line and associated vegetation.

- Linear infrastructure (access roads) will mainly impact on water quality through erosion and sedimentation. Mitigation measures for impacts related to erosion and sedimentation are dealt with separately in *Section 9.1.3*.

- Water quality monitoring during rehabilitation works should monitor pH, EC, TDS, temperature, turbidity and dissolved oxygen on a weekly basis. For the rehabilitation of the plunge pool, these measurements can be taken from the river bank at 200m, 500m and 1km intervals downstream from the instream activities. Measurements at the 1km monitoring point should remain below threshold values as provided in the water quality monitoring plan (refer to Part III of the ESIA). Hydrocarbons, major ions (Sulphates, Chlorides, Calcium, Magnesium, Sodium, Carbonates/ Bicarbonates) and nutrients (total Nitrogen and total Phosphates) should be monitored in line with the water quality monitoring plan.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact to water quality will be a **Minor Negative Impact** post mitigation (refer to *Table 9.4*).

Table 9.4 Rating of Residual Impacts Related to Water Quality (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	Although the intensity of contamination can be mitigated the extent will remain approximately the same.
Duration	Short Term	Mitigation efforts aimed to decrease the duration of exposure if contamination does occur will decrease the magnitude of water quality related impacts.
Scale	Small	Rapid mixing under current operational flow regimes.
Frequency	Low	Minimal or concentrated blasting, decant and spill events are preferential to frequent diluted release.
Likelihood	Possible	Overall downward adjustment in the likelihood of water pollutions.
Magnitude		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		

9.1.3 Impacts on Erosion and Sedimentation

Description of Baseline Environment

The Zambezi channel bed has lowered since the construction of Kariba Dam and the channel has widened in places downstream of the gorge. The rate of channel widening has decreased in subsequent years, inferring stable condition under current bed load capacity. This along with the altered flow regime and the dam obstruction resulted in sediment and nutrient deprivation. The gorge itself is well armoured by basement rock and unlikely to be affected by erosion although additional sediment inputs may result in changes in water quality and the existing habitat template.

Proposed Project Activities

During rehabilitation works, the removal and disturbance of vegetation and soil as well as blasting activities poses a risk for erosion and sedimentation related impacts. Potential sources of impact related to sediment loads have been identified during: (i) the construction and operation of the temporary access roads, (ii) discharge from the plunge pool, (iii), blasting and rock removal activities, (iv) construction of the downstream cofferdam and (v) dredging of the slipway site. Potential sources of sediment are briefly discussed below:

- Activities associated with rehabilitation works such as clearing and grubbing, topsoil removal, trenching and storage of materials (e.g. topsoil stockpiles) could result in erosion and sedimentation, particularly during rainfall events.

- Water within the plunge pool could potentially become sediment laden during rehabilitation works. It is expected that sediment and silt will accumulate at the bottom of the pool over time.

- Blasting activities and the transport of rock aggregate to the deposit area will result in dust settlement.

- Disturbance of the river bed and banks during the construction of the cofferdam.

- The dredging of the bed at the proposed spillway site will probably cause the re-suspension of silt within the water column.

Sensitive Receptors

As with water quality and flow related issues, the majority of the instream community reflected a tolerance to habitat alteration induced by erosion and sedimentation. However, the extent and duration of erosion and sedimentation will also influence the overall significance of these impacts. It thus remains pertinent to give due consideration to suitable mitigation measures.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact of erosion and sedimentation on the water quality and habitat template of the receiving environment will be a **Minor Negative Impact** pre-mitigation (refer to *Table 9.5*).

Table 9.5 Rating of Impacts Related to Erosion and Sedimentation (Pre-Mitigation)

Type of Impact		
Direct and Indirect Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The extent of the proposed activities are localised and the size and scale of the receiving environment will further reduce the extent of erosion and sedimentation impacts.
Duration	Short Term	Direct sediment issues may arise through instream activities and will be of shorter duration than indirect sediment laded runoff from exposed surfaces and destabilised non-perennial systems.
Scale	Small	Little or no sediment is currently present in the gorge directly downstream of the dam. Additional sediment is highly unlikely to have negative effect on the system. Erosion within the channel is unlikely due to the resistant geological substrate.
Frequency	Moderate	Blasting, decant and spill events dependant.
Likelihood	Likely	Instream construction activity comes with a high likelihood of sediment generation.
Magnitude		

Small Magnitude
Sensitivity/Vulnerability/Importance of the Resource/Receptor
Medium Sensitivity
Increase in sediment will have greater consequences for changes in water quality, which in turn may have implications for instream aquatic biota. In general the biological receptors are tolerant and moderately tolerant to variation in the habitat template.
Significant Rating Before Mitigation
Minor Negative Impact

Mitigation/Management Measures

- Erosion and silt control mechanisms should be in place prior to the onset of rehabilitation within any watercourse. This includes the elimination of surface flow through the active work site. Silt fences or hay bales need to be placed near the base of an exposed slope in order to limit the amount of sediment entering the watercourse.

- Depending on the silt load suspension within the plunge pool, it may be necessary to delay dewatering until sediment has settled or until turbidity levels downstream of the discharge point do not vary with more than 10% to that of background values (see water quality monitoring plan).

- The erection of silt barriers along all affected drainage lines should be undertaken to curb any sediment and silt run-off in the preparation of rehabilitation activities. Ideally, the amount of land that will be disturbed should be kept to an absolute minimal.

- Non-erodible materials should be used for the construction of any berms, cofferdams or other isolation structures.

- Spoil piles should be placed above the high water mark in distinct piles and adequate erosion measures should be implemented in order to minimise and reduce erosion and siltation into the watercourse from spoil piles.

- Runoff control features should be designed to minimise soil erosion and avoid placement of infrastructure on unstable slopes.

- Erosion control measures should be inspected regularly (at least weekly during the wet season) during the course of rehabilitation works and necessary repairs need to be carried out if any damage has occurred.

- Turbidity is a suitable surrogate for monitoring increased sediment loads. Monitoring criteria for turbidity are provided in *Section 9.1.2* under the *Mitigation/Management Measures* subsection.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact to aquatic ecology due to erosion and sedimentation will be a **Negligible Negative Impact** post mitigation (refer to *Table 9.6*).

Table 9.6 Rating of Residual Impacts Related to Erosion and Sedimentation (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The extent of sedimentation can readily be controlled at source or by decreasing the spatial extent of disturbance.
Duration	Temporary	Duration of the impact can be reduced by decreasing the temporal extent of disturbance.
Scale	Small	Large volumes of additional sediments are required to negatively affect the downstream system.
Frequency	Intermittent during rehabilitation works	Sediment releases will be a result of surface runoff, blasting, decant and spill events during rehabilitation works.
Likelihood	Likely	Although the intensity of the impact can be reduced by manipulating the extent and duration, the likelihood of sediment pluming occurring remains high.
Magnitude		
Negligible Magnitude		
Significant Rating After Mitigation		
Negligible Negative Impact		

9.2 IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

9.2.1 *Impacts on the Aquatic Environment*

Description on Baseline Environment

Sites on the Kariba Dam and the Zambezi River downstream of the dam were in a good and moderate ecological state according to the diatom community. The community at sites reflected slightly alkaline, fresh-brackish, oxygenated waters with moderate pollution.

The macroinvertebrate assemblage is considered largely modified due to a knock-on effect from flow regulation from the dam on habitat, connectivity and water quality. A decrease in diversity and a large loss of macroinvertebrate families with requirements for various flow conditions were noted. Although all metrics show a change from reference conditions, the major driver of change in the system is hydrology, which has a subsequent impact on habitat, connectivity and water quality.

Baseline fish assemblages reflected a moderate to large variation from reference assemblages. The most notable cause for this change is alteration in the natural flow regime and a change in velocity depth constituents from the reference conditions. A longitudinal improvement in fish assemblage was noted.

Proposed Project Activities

Rehabilitation activities relating to dredging, blasting and dewatering are likely to result in direct fish mortalities due to the proximity of these activities to the instream environment.

Sensitive Receptors

In addition to subtle changes in community structure, brought on by changes in water quality, flow and sediment, more acute responses are also possible. For example, blasting and dewatering activities may directly cause fish mortalities, while the leakage of more hazardous (i.e. hydrocarbons, solvents and chemicals) substances or intense sediment plumes may also result in instream responses.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact of blasting, dewatering and other instream activities on the instream aquatic community of the receiving environment will be a **Moderate Negative Impact** pre-mitigation (refer to *Table 9.7*).

Table 9.7 Rating of Impacts Related to Aquatic Biota (Pre-Mitigation)

Type of Impact		
Direct Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Mortalities of instream biota induced by blasting and dewatering activities will be localised.
Duration	Short Term	The temporal extent and frequency of blasting and dewatering is short lived.
Scale	Small	Instream impacts to biota will be localised.
Frequency	Intermittent during rehabilitation works	Blasting and dewatering activity will last for the duration of rehabilitation works.
Likelihood	Likely	Blasting and direct mortalities due to instream activities are likely to occur due to the proximity of the activities to the instream community.
Magnitude		
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Medium Sensitivity		
Significant Rating Before Mitigation		
Moderate Negative Impact		

Mitigation/Management Measures

Most impacts expected to affect aquatic biota have been discussed under previous sections. Implementing recommendation and mitigation measures for impacts related to water quality, hydrology, erosion and sedimentation, will also mitigate most expected impacts on aquatic biota. Aquatic biota may further be impacted by mortalities directly associated to instream activities such as blasting and dewatering. Local literature on mitigating blasting impacts on instream biota is limited, but international literature suggests that blasting induced over pressure should not exceed a 100 kPa and peak particle velocity should not exceed 13mm/s (Sean *et al.*, 2008; Kolden & Aimone-Martin 2013).

Fish killed as a result of blasting (1) will die due to the shock wave, which causes their swim bladders to rupture. Some fish will float to the surface, but it is likely that most will sink to the bottom. There is a risk that fish, if exposed to large amounts of TNT over long periods of time, will become harmful to human health if consumed (ATSDR, 1995). For this, and other health reasons, fish destined for human consumption, should be collected immediately after the explosion, while any fish remaining in the water for extend periods should not be consumed. Collected fish should be distributed fairly to communities in the AOI.

In addition to blasting, fish may become isolated and trapped within the plunge pool area during dewatering activities. This may provide a good opportunity to further the taxonomic resolution of fishes of the middle Zambezi River. Fish trapped within the dewatered area can be removed via gill and seine netting. The latter is the preferred method and released within the downstream area. A representative sample of the fish community may be preserved appropriately and provided to local and international institutions for curation.

A biomonitoring regime, before during and after rehabilitation should be instated. The methodologies and metrics included in the baseline aquatic ecology report should be repeated at the same biomonitoring points on a quarterly basis during rehabilitation works and reduced to biannual basis for a period of two years following the end of rehabilitation works. The main criteria for instream biomonitoring are represented in the ESMP (refer to Part III of this ESIA).

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact to the instream community will be a **Minor Impact** post mitigation (refer to *Table 9.8*).

(1) **Please Note** - this study assumes that TNT will be used.

Table 9.8 Rating of Residual Impacts Related to Aquatic Biota (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Ensuring that the over pressure and peak particle velocity remains below the thresholds provided and implementing catch and release of fish within the dewatered area, the extent of the impact on the instream community can be decreased.
Duration	Temporary	Rapid construction and deconstruction of cofferdam and isolation of instream activities as quickly as possible from river processes will decrease temporal extent of impacts owing to instream activities.
Scale	Small	Current conditions are already altered; mitigated impacts will further reduce the scale.
Frequency	Intermittent during rehabilitation	Remains bound during rehabilitation activities, mostly related to dewatering and blasting.
Likelihood	Possible	Some mortality remains likely to occur under normal operating conditions.
Magnitude		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		

9.2.2 *Impacts on Terrestrial Habitat*

Description of the Baseline Environment

The broad habitats on the Zimbabwean side of the border are largely natural, whereas modified habitats are widespread on the Zambian side. The natural habitats of the valley floor are widespread and do not support many endemic or threatened species. The Kariba Gorge has been classified as a Critical Habitat however the upper extent in the vicinity of the dam is heavily impacted by previous construction works and long term operation of the Kariba Hydropower Scheme. The project site is located within the Lower Zambezi Transfrontier Conservation Area (TFCA), which qualifies as a protected area. This protected area extends over both sides of the border incorporating parts of Zambia and Zimbabwe.

Waste materials from excavation of the plunge pool will be dumped into an existing quarry site on the north bank (Zambian side) which qualifies as a modified habitat of little known ecological value. The slipway that will be used to assemble and launch the floating cofferdam within Lake Kariba is already used as a boat jetty, while the shores of Lake Kariba have not developed a riparian fringe and have a low biodiversity value.

Proposed Project Activities

Areas impacted by rehabilitation works activities will extend over both Zambia and Zimbabwe and will include a general construction site on the Zambian side of the river; widening and upgrading of existing access roads; the construction of an access road into the plunge pool below the dam;

construction of the cofferdam; the deposition of waste rock in the existing disused Sinohydro Quarry Site in Zambia; access to the waste rock dumpsite and access to and the existing slipway in Zimbabwe.

An area of direct terrestrial ecological influence has been defined as the general construction site on the Zambian side of the river, the temporary access road into the plunge pool area, the access road to the waste rock dumpsite, the dumpsite itself, access to the spillway on the Zimbabwean side of the river and the slipway area itself.

Sensitive Receptors

The sensitive receptors for this impact are the natural habitats as described above in the *Description of the Baseline Environment*. The project site is located within the Lower Zambezi TFCA.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact on terrestrial habitat loss will be a **Negligible Negative Impact** pre-mitigation (refer to *Table 9.9*).

Table 9.9 Rating of Impacts Related to Terrestrial Habitat Loss (Pre-Mitigation)

Type of Impact		
Direct Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Loss of terrestrial habitats will be restricted to the direct terrestrial ecological area of influence
Duration	Long term	Areas may recover but will take a long time if left to natural processes
Scale	Small	The extent of the rehabilitation and quarry footprints are small
Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Definite	Rehabilitation works are expected to proceed as planned
Magnitude		
Small Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Low to Medium Sensitivity		
The specific sites identified for rehabilitation works or sourcing of materials are modified habitats, but isolated in extent and located within extensive natural habitats		
Significant Rating Before Mitigation		
Negligible Negative Impact		

Mitigation/Management Measures

- **Appoint and Authorise an Environmental Officer** – a qualified and competent Environmental Officer should be appointed with sufficient authorisation to ensure protection of the environment is prioritised.

He/she should ensure that mitigation listed with the ESMP is implemented to minimise environmental impacts.

- **Incorporate Ecological Awareness into Induction Programmes** – induction programmes for staff, contractors and site visitors should emphasise that many of the active work areas are inside protected areas and should include the importance of minimising the disturbance to the environment. Measures around the appropriate handling of wildlife (including dangerous species) should be included (*Section 9.2.3*).

- **Avoid Footprint Creep –** measures should be taken at the planning stage to determine the minimum required area for all rehabilitation works, equipment laydown sites, construction vehicle parking, erection of staff toilet facilities, construction viewing sites and other activities not listed here. These areas should be clearly marked on the ground prior to the onset of activities and edge markers pointed out to staff and contractors to ensure that activities remain within their minimum required area.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact associated with terrestrial habitat loss will remain as a **Negligible Negative Impact** post mitigation (refer to *Table 9.10*).

Table 9.10 Rating of Residual Impacts Related to Terrestrial Habitat Loss (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The extent of terrestrial habitat loss will not change as a result of mitigation measures and shall remain restricted to the direct ecological area of influence
Duration	Medium term	Rehabilitation of disturbances will decrease the duration of the impact
Scale	Small	The extent of the rehabilitation footprint are small
Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Definite	Rehabilitation works are expected to proceed as planned
Magnitude		
Negligible Magnitude		
Significance Rating After Mitigation		
Negligible Negative Impact		

9.2.3 Impacts on Terrestrial Species of Conservation Concern

Description of the Baseline Environment

The baseline assessment states that *Cyclantheropsis parviflora* (a Vulnerable plant species) occurs in the Kariba Gorge. Various threatened mammal species may occur in the greater area such as Endangered Wild Dogs and other predators, but these species are mobile and typically avoid active work zones. A large elephant population occurs within the Zimbabwean side of the Ecological AoI but are not expected within the Kariba Gorge, the slipway or quarry sites.

Bird species of concern include Southern Carmine Bee-eater (*Merops nubicoides*), African Skimmer (*Rhynchops flavirostris*) and Rock Pratincole (*Glareola nuchalis*). The latter species is a migrant that depends on emergent rocks within fast-flowing rivers and is expected to occur within the downstream reaches of the Zambezi River during the low flow season. These birds may be displaced by rehabilitation activities within the plunge pool, but the area of displacement represents a small area of their available habitat. Large colonies of Southern Carmine Bee-eaters (not threatened) exist in the exposed sandbanks and are vulnerable to disturbance.

Large crocodiles occur in Lake Kariba many individuals were observed downstream of the wall during aquatic studies in Sept 2014. Some individuals may be displaced, however the crocodile population in the area has grown substantially over the past three decades and this species is not considered to be at risk.

Proposed Project Activities

Please refer to *Proposed Project Activities* in on *Page 9-15* in *Section 9.2.2*.

Sensitive Receptors

The sensitive receptors for this impact are those species as described above in the *Description of the Baseline Environment*.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the significance of the impact on species of conservation concern will be a **Minor Negative Impact** pre-mitigation (refer to *Table 9.11*).

Table 9.11 Rating of Impacts Related to Species of Conservation Concern (Pre-Mitigation)

Type of Impact		
Direct Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Any impacts to species are expected to be restricted to the direct terrestrial AoI.
Duration	Short term	Impacts to species are expected to be to individuals and no whole populations would be impacted. Populations could recover during the short term.
Scale	Small	Species losses would be to individuals and not to populations and the scale of an impact to any one species is expected to be small.

Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Possible	Loss of individuals may occur in the form of accidents or loss of habitats. Species of conservation concern generally occur in low abundance and likelihood of impacts are reduced as a result of the small Project footprint.
Magnitude		
Small Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Low to Medium Sensitivity		
There is a Vulnerable plant species in the Kariba Gorge however all other species of conservation concern that are likely to be impacted are not threatened.		
Significant Rating Before Mitigation		
Minor Negative Impact		

Mitigation/Management Measures

- **Implement an Animal Rescue Plan** – many of the rehabilitation activities are located within a protected area (refer to *Figure 8.28* in *Chapter 8*) and there is a high likelihood that animals may become trapped or unexpectedly cornered. Many animals can be dangerous when trapped or cornered (including snakes, carnivores, horned antelope, porcupines and others) and adequate training should be undertaken to handle a range of potential wildlife interactions. Wildlife authorities are present in both Zambia and Zimbabwe and private veterinary skills are available. Arrangements should be put in place with relevant persons of authority or with appropriate capacities to be on call and able to react. Their contact details should be appropriately circulated amongst rehabilitation work teams and included in induction programmes for use in the event of an incident involving a dangerous or potentially dangerous animal.

- **Recognise Threatened and Protected Species and Translocate Appropriately** – various threatened and protected species of plants and animals are present in the Project AOI and surrounds. An Environmental Officer, or a member of his/her staff should be able to recognise these species and scan areas prior to the start of rehabilitation activities to determine if present or potentially present (in the case of animals), and take appropriate steps based on the species involved. Actions should include one of the following:

  - Areas with an occurrence of threatened plants should be avoided where possible (such as parking or equipment laydown that can be shifted);
  - Threatened plants that will be lost due to activities should be translocated to nearby but safe areas of similar habitat.
  - Warnings should be presented to rehabilitation work teams regarding possible incidence of faunal interactions (such as snakes from rocky outcrops to be cleared).

* **Illegal Hunting** – the following activities should be prohibited by all personnel associated with the proposed Kariba Dam Rehabilitation Project within and surrounding the Project Area, both during and outside work hours:

    - Any forms of hunting of wildlife or fishing by staff and contractors.

    - Purchase or transport of fuel wood from/for surrounding communities.

    - Purchase, sale or transport of any bush meat products from local communities or passing traders.

    - Collection of any animals or animal products for consumption, medicinal or other use.

    - Camp residents keeping pets, either introduced species such as cats or dogs, or native wildlife.

    - Camp residents purchasing local wildlife for any reason.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact to species of conservation concern will be a **Minor Negative Impact** post-mitigation (refer to *Table 9.12*).

Table 9.12 Rating of Residual Impacts Related to Species of Conservation Concern (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The extent of impacts to species are expected to reduce as a result of mitigation
Duration	Short term	Impacts to species are expected to be to individuals and no whole populations would be impacted. Populations could recover during the short term.
Scale	Small	Biodiversity losses would be to individuals and the number of individuals affected can be reduced, but will the scale of the impact will remain small.
Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Possible	Loss of individuals may reduce as a result of mitigation but will remain possible.
Magnitude		
Small Magnitude		
Significance Rating After Mitigation		
Minor Negative Impact		

9.2.4 *Impacts on Protected Areas*

Description of the Baseline Environment and Sensitive Receptors

The area downstream of the dam up to the Mozambique border consists of National Parks and extensive transfrontier conservation areas, including the Lower Zambezi TFCA. The Mana Pools National Park and adjacent conservation areas are recognised as a UNESCO World Heritage Site and the Zimbabwean side of the lower Zambezi River is also recognised as an Important Bird Area. The wildlife areas on both sides of the river are popular tourist destinations.

Flow releases from the Kariba Dam are controlled and the regular flooding of the downstream habitats no longer occurs. Extensive riparian habitats on the downstream floodplain have been affected, and germination recruitment of the dominant canopy trees is inhibited. These conservation areas are important tourist destinations with international recognition but the habitats are in a gradual state of decline.

Proposed Project Activities

Please refer to *Proposed Project Activities* in on *Page 9-15* in *Section 9.2.2*.

Sensitive Receptors

The Project is located within the Lower Zambezi TFCA. In Zambia this TFCA includes the Open Area around Siavonga down to Chirundu, Chiawa Game Management Area and Lower Zambezi National Park. In Zimbabwe the TFCA includes the Charara, Urungwe and Rifa Safari Areas between Kariba and Chirundu, Mana Pools National Park, Sapi and Chewore Safari Areas down to Kanyemba.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the significance of the impact to protected areas will be a **Moderate Negative Impact** pre-mitigation (refer to *Table 9.13*).

Table 9.13 Rating of Impacts Related to Protected Areas (Pre-Mitigation)

Type of Impact		
Indirect Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	Large protected areas occur downstream of the project site and have extensive coverage along the Zambezi River.
Duration	Medium term	Possible impacts may occur for the duration of the rehabilitation period and shortly thereafter.
Scale	Small	Cumulative impacts occur as a result of Kariba operation, however the severity of impacts resulting from the current project are not expected to be great.

Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Unlikely	The protected areas cover a large area and the likelihood of impacts associated with this project being detected within the greater area are considered to be unlikely.
Magnitude		
Small Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
High Sensitivity		
Large protected areas supporting large and healthy populations of wildlife exist downstream of the Kariba Dam.		
Significant Rating Before Mitigation		
Moderate Negative Impact		

Mitigation/Management Measures

- **Maintain Dialogue and Collaboration with Protected Area Authorities –** an open communication should be maintained with conservation authorities to ensure that they are familiar with future plans, activities taking place and are provided with opportunity to advise on day-to-day measures to minimise possible impacts. Their advice and support should be considered regarding an animal rescue plan and translocation of species. Responsibilities should be delegated (e.g. to the Environmental Officer) for ensuring regular communication occurs with conservation authorities.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impacts to protected areas will be a **Negligible Negative Impact** post-mitigation (refer to *Table 9.14*).

Table 9.14 Rating of Residual Impacts Related to Protected Areas (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	Large protected areas occur downstream of the project site and have extensive coverage along the Zambezi River.
Duration	Medium term	Possible impacts may occur for the duration of the rehabilitation works and shortly thereafter.
Scale	Small	Cumulative impacts occur as a result of Kariba operation, however the severity of impacts resulting from the current project are not expected to be great.
Frequency	During rehabilitation works	Remains bound during rehabilitation activities.
Likelihood	Unlikely	The protected areas cover a large area and the likelihood of impacts associated with this project being detected within the greater area are considered to be unlikely.
Magnitude		
Negligible Magnitude		
Significance Rating After Mitigation		
Negligible Negative Impact		

9.3 IMPACTS ON THE SOCIAL ENVIRONMENT

9.3.1 Impacts on Tourism

Description of the Baseline Environment

An unintended consequence of the construction of the Kariba Dam has been the emergence of a thriving tourism industry, especially at the wall. Visitors are attracted to the water body and the surrounding rural/natural environment. A variety of activities such as safaris, boating, fishing, sunset cruises, canoeing, water sports, bird watching, cultural village tours and visiting look-out points are sought after. The tourism industry also supports a large informal trade sector whose customers are mainly tourists.

The majority of the mentioned activities happen upstream from the dam and adjacent to the lake on both sides of the river/lake. The wall itself was constructed in a narrow gorge and thus blends in well with the landscape. Downstream of the wall, there are two look-out points facing the wall which are popular tourist stops (*i.e.* at the Zimbabwean Tourism Authority Offices (ZTA) and at the wall itself).

Proposed Project Activities

Rehabilitation activities with the most likely impact on tourism are probably associated with blasting for rehabilitation of the plunge pool. It is anticipated that blasting activities will take place over a six month period. Depending on the safety risk linked to the blasting, it is possible that there will be temporary access restrictions to the wall when blasting occurs. It is, therefore, possible that rehabilitation activities may result in a slight disturbance to tourism activities in the area.

Sensitive Receptors

Although tourists visiting the dam may be disappointed by the undertaking of rehabilitation works they cannot be considered sensitive, as there are numerous other (upstream) tourist activities that will not be affected by rehabilitation works. In contrast, it is anticipated that rehabilitation works may attract tourism to the area, as many tourists may in fact be interested in Kariba Dam rehabilitation works. As such, although tourists are regarded as possible sensitive receptors, their level of sensitivity is considered to be low.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact on tourism will be a **Negligible Negative Impact** pre-mitigation (refer to *Table 9.15*).

Table 9.15 Rating of Impacts on Tourism (Pre-Mitigation)

Type of Impact		
Direct and Indirect Negative		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The impact will be restricted mainly to those that visit the two look-out points on either side of the Kariba Dam.
Duration	Short term	The impact associated with rehabilitation of the plunge pool will occur for 7 months during the dry season for the first four years of rehabilitation works.
Scale	Small	The impact will affect a very small number of people.
Frequency	During rehabilitation works	Remains bound during rehabilitation activities associated with the plunge pool.
Likelihood	Likely	Rehabilitation works will take place
Magnitude		
Negligible to Small Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Low Sensitivity		
The impact will only affect tourists visiting the area during rehabilitation works. It is not expected that the Project will deter visitors from visiting the area.		
Significant Rating Before Mitigation		
Negligible Negative Impact		

Mitigation/Management Measures

The following mitigation and management measures are proposed:

- Installation of project information boards, which provide a brief description of rehabilitation works, Project timeframes as well as the blasting schedule.

- Sharing of Project description and rehabilitation schedule with tourism operators.

- Implementation of noise and dust abatement measures as required.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance will be a **Negligible Negative Impact** post mitigation (refer to *Table 9.16*).

Table 9.16 Rating of Residual Impacts to Tourism (Post-Mitigation)

Type of Impact		
Direct and Indirect Negative		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The impact will be restricted to those visiting the look-out points.
Duration	Medium	The impact associated with rehabilitation of the plunge pool will occur for 7 months during the dry season for the first four years of rehabilitation works.
Scale	Small	The impact will affect a very small number of people.
Frequency	During rehabilitation works	Remains bound during rehabilitation activities associated with the plunge pool.
Likelihood	Likely	Rehabilitation works will take place
Magnitude		
Small Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Low Sensitivity		
Significant Rating Before Mitigation		
Negligible Negative Impact		

9.3.2 *Impact on Fisheries-Based Livelihoods*

Description of the Baseline Environment

Commercial and artisanal fishing occurs on Lake Kariba and in the river, downstream of the dam. Commercial fishing activities are mainly focussed upstream of the wall and limited artisanal fishing upstream and downstream of the wall. Fishing methods (lake and river) include gillnets, dip nets (especially for *kapenta*) and lines and hooks.

On both sides of the river, a significant number of people derive their livelihoods from fishing. People from other parts of Zimbabwe and Zambia migrate to the Kariba and Siavonga districts to pursue fishing as a means to make a living. The presence of tourism operators and activities in the AoI plays a big role in supporting the survival of the fishing industry.

Proposed Project Activities

As is described in *Section 9.1.2* impacts on water quality during rehabilitation works is considered likely. Moreover, (and as is described in *Section 9.1.3*) the removal and disturbance of vegetation and soil as well as blasting activities poses a risk for erosion and sedimentation related impacts.

Sensitive Receptors

Sensitivity in this case relates to fragile livelihood strategies, income instability, lack of food security and poverty. The most sensitive receptors are downstream fishers who may lose an important source of nutrition and income if activities associated with the rehabilitation works change the water quality to such an extent that it negatively affects the fish population. It is unlikely that the fishers will be able to find an alternative source of nutrition and income easily.

Significance of Impact (Pre-mitigation)

Based on the analysis provide above, it is anticipated that the impact on fisheries-based livelihoods will be a **Negligible to Moderate Negative Impact** pre-mitigation (refer to *Table 9.17*).

Table 9.17 Rating of Impacts on Fisheries-based Livelihoods (Pre-Mitigation)

Type of Impact		
Indirect and Negative		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Fish mortalities by blasting and dewatering activities will be downstream of the Kariba Dam and highly localised.
Duration	Short term	The temporal extent and frequency of blasting and dewatering is short lived. Moreover, issues associated with direct sediment through instream activities will be of short duration. The resultant impact on fish downstream of the dam will be short lived, and it is unlikely that this will result in a reduction in fish catches.
Scale	Small	From a water quality perspective, reduced instream flows will result in concentration of pollutants. Additional sediment is highly unlikely to have negative effect on the system. Erosion within the channel is unlikely due to the resistant geological substrate. The resultant impact on fish downstream of the dam will be highly localised, and it is unlikely that this will result in a reduction in fish catches downstream.
Frequency	Moderate	Blasting, decant and spill event dependant.
Likelihood	Likely	Some form of water contamination is likely to occur owing to the nature of the proposed activities. The main impacts relate to sediment pluming, during instream and dewatering activities, and nutrient releases during blasting.
Magnitude		
Low to Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
High Sensitivity		

Down-stream artisanal fishers are identified as sensitive receptors as it is unlikely that they have access to alternative sources of income and nutrition.
Significant Rating Before Mitigation
Negligible to Moderate Negative Impact

Mitigation/Management Measures

The management of water quality during the drawing down of the plunge pool and subsequent rehabilitation activities will be challenging. The following mitigation and management measures are proposed regarding the down-stream fishers:

- The mitigation/management measures as recommended in *Section 9.1.2* and *Section 9.1.3* (on *Page 9-7* and *Page 9-11* respectively) should be implemented.

- An aquatic monitoring program should be implemented that will enable an early identification of a decline in fish numbers and associated fish catches downstream. If changes are observed, the ZRA should working with NGOs and Government to develop a mitigation and compensation plan.

Residual Impact (Post-mitigation)

Post-Mitigation the expected significance of the impact on fisheries-based livelihoods is expected to be a **Minor to Negligible Negative Impact** (refer to *Table 9.18*).

Table 9.18 Rating of Residual Impacts on Fisheries-based Livelihoods (Post-Mitigation)

Type of Impact		
Indirect and Negative		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	Although the intensity of contamination can be mitigated the extent will remain approximately the same.
Duration	Short term	Mitigation efforts aimed to decrease the duration of exposure if contamination does occur will decrease the magnitude of water quality related impacts. Moreover, the duration of impacts associated with erosion and sedimentation can be reduced by decreasing the temporal extent of the disturbance. The resultant impact on fish downstream of the dam will remain short lived, and it is unlikely that this will result in a reduction in fish catches.
Scale	Small	From a water quality perspective, the mixing of contaminants under current operational flow regimes will be rapid. Additional sediment is highly unlikely to have negative effect on the system. Erosion within the channel is unlikely due to the resistant geological substrate. The resultant impact on fish downstream of the dam will be highly localised, and it is unlikely that this will result in a reduction in fish catches downstream.

Frequency	Low	Minimal or concentrated blasting, decant and spill events are preferential to frequent diluted release.
Likelihood	Possible	Overall downward adjustment in the likelihood of water pollutions.
Magnitude		
Small Magnitude		
Significant Rating Before Mitigation		
Minor to Negligible Negative Impact		

9.3.3 *Creation of Employment Opportunities*

Description of the Baseline Environment

Formal employment opportunities in the AoI are very limited. The sectors providing formal employment are Government, the energy parastatals ZESA and ZESCO, and the formal tourism and fisheries sectors. The informal trading and fishing sectors are however the biggest employer in the AoI.

Proposed Project Activities

Rehabilitation activities associated with the plunge pool and spillway will create an as yet unknown number of employment opportunities, which will be distributed over the duration of approximately 7 years. Rehabilitation activities of the plunge pool is planned for during dry seasons (7 months per year) over an estimated four year period and the spillway for a period of approximately 8 years.

There are 2 factors that will influence the actual number of employment opportunities that will realistically be available to prospective employees in the AoI, namely skills levels and structuring of employment contracts by the Contractor.

It is foreseen that due to the highly specialised nature of the rehabilitation works; a large number of the opportunities will be for highly skilled and skilled perosns e.g. engineers, shutterhands, drillers and blasters, steel fixers, machine operators, concrete hands and drivers while a relatively small number of opportunities will be available for unskilled labour such as for security, housekeeping and catering staff.

Sensitive Receptors

With regard to the creation of employment opportunities, unskilled employment seekers are most vulnerable because most of the available opportunities will be skilled and highly skilled people.

Within the pool of unskilled employment seekers, female and disabled unskilled job seekers will be the most vulnerable.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact on employment creation on those seeking employment will be a Positive **Impact** pre-mitigation (refer to *Table 9.19*).

Table 9.19 Rating of Impacts Related to Employment Creation (Pre-Mitigation)

Type of Impact
Positive Impact
Employment opportunities will provide a cash income to employees for the duration of the employment opportunity and contribute to households having more disposable income to contribute to improved livelihoods.

Enhancement and Management Measures

The following management measures are proposed to enhance this impact:

- The development of Project specific Recruitment Policies by the Project Proponent, the Engineer as well as the Contractor.
- The setting of targets to maximise the number of Zambian and Zimbabwean nationals, to consider the gender balance for available local jobs. Consideration of targets for disabled, unskilled, skilled and highly skilled employees from the AoI.
- Targets to become part of Conditions of Contract with Engineer and Contractor.
- Preparation of monthly and cumulative employment statistics reports for submission to Project Proponent.
- Conduct an annual audit of employment statistics based on which an incentive for achieving employment targets can be considered.
- Public advertising of employment opportunities in all newspapers, public libraries, the District Office and in all relevant languages.
- The establishment of a Recruitment Office by the Contractor with the purpose of keeping a record of available prospective employees, their skills levels and contact details. Registration of job seekers with the Recruitment Office will be free of charge.

9.3.4 Procurement of Goods and Services

Description of the Baseline Environment

The economies of the AoI in both countries are driven mainly by the fishing, agriculture and tourism sectors. No industrial activities were witnessed on either side of the border in the AoI. Typical economic activities include informal trading, commercial and subsistence fishing and tourism activities. Although both countries have the ability at a national level to supply goods and services needed in the mining and construction sectors, this ability does not stretch as far as the AoI.

Proposed Project Activities

During rehabilitation of the Kariba Dam, there will be a significant requirement for the procurement of construction equipment, goods and services. Although it is expected that some of the equipment will have to be specially designed and manufactured for the project and thus would have to be imported, there will also be procurement opportunities for local, regional, and national businesses to make a meaningful contribution to the economies of both countries. Zambia and Zimbabwe will primarily benefit through procurement from the civil engineering and construction industry and the hospitality and service industry through the provision of accommodation, catering, transport, vehicle servicing and security services.

The Proponent, Engineer and Contractor will be bound to achieving a certain target percentage of their envisaged procurement locally, regionally and nationally to ensure that these benefits find their way into the national economies.

Sensitive Receptors

The sensitive receptors for this aspect are the entry level and small and medium contractors and service providers who have the technical skill and know-how to support the Project, but who are not used to delivering goods and services at the required quantities and rate as needed for the Project. Furthermore, it is unlikely that these parties have the business support structures in place to respond to sourcing and delivery challenges as well as the administrative challenges that come with invoicing and payment.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact on the procurement of goods and serviced will be a **Positive Impact** pre-mitigation (refer to *Table 9.20*).

Table 9.20 Rating of Impacts regarding the Procurement of Goods and Services (Pre-Mitigation)

Type of Impact
Positive Impact
This is a positive impact. The extent of the impact will possibly be curtailed mainly due to administrative challenges and the inability by in-country businesses to respond at the required speed and quantities required by the project authorities.

Enhancement and Management Measures

It is proposed that the Project Proponent, as well as the Consulting Engineer and the Contractor are tasked with developing their own Procurement Strategies. It is anticipated that these strategies will be designed to encourage Project authorities and their design and construction consultants to stimulate in-country business opportunities at local, regional and national level through incentivising in-country procurement.

To the greatest extent possible, mentioned Procurement Strategies should provide for:

- The establishment of a service provider database by the Contractor (also for use by the Engineer and Project Proponent). The database should reflect the name, type, location, contact details and capacity of the businesses as a minimum.

- The unbundling of contracts into smaller and more manageable packages so that in-country and possibly less experienced local and regional suppliers have a better chance of being selected.

- Setting procurement targets for different business categories e.g. per sector or in terms in-country or women ownership and or management of the business.

- Tracking of performance against procurement targets and issuing of quarterly performance reports to the Project Proponent.

- Basic capacity building support to in-country businesses to assist them with responding to tender opportunities and meeting administrative requirements of written communication, invoicing and reporting.

- Advertising of procurement opportunities according to a specific, agreed and well–communicated method and medium.

9.3.5 Impacts related to Possible Unfair and Unsafe Working Conditions

PLEASE NOTE:

This Section discusses the possible impacts that employees will be exposed to if illegal, unfair and unsafe labour conditions are practised by employees. This possible impact was identified during stakeholder engagement sessions in the AoI. This impact is alleged to be particularly relevant to Chinese contractors with a reputation for unfair and unsafe working conditions.

Description of the Baseline Environment

In Zimbabwe, the Labour Act and its amendments (16/1985, 12/1992, 20/1994, 22/2001, 17/2002) regulates the conditions of employment and remuneration of employees. The same act deals with matters of occupational health and safety.

In Zambia, conditions of employment and remuneration are regulated by the Employment Act, the Minimum Wages and Conditions of Employment Act, the Workers' Compensation Act of 1999, and the Occupational Health and Safety Act of 2010 amongst others.

Both countries are members of the International Labour Organisation (ILO), which means that they subscribe to the following:

- Definition of unfair labour practices;
- Regulate conditions of employment and related matters;
- Provide for control of wages and salaries;
- Provide for the appointment and functions of workers' committees;
- Provide for the formation, registration and functioning of trade unions, employers' organizations and employment councils;
- Regulate the negotiation, scope and enforcement of collective bargaining agreements;
- Provide for the establishment and functioning of a labour court;
- Provide for the prevention of trade disputes and unfair labour practices;
- Regulate and control collective bargaining;
- Regulate and control employment agencies; and
- Provide for matters connected with or incidental to the aforementioned.

Proposed Project Activities

The number of employment opportunities has not yet been determined. It is however expected that employment opportunities will include all skill levels from unskilled to highly skilled and that the labour force will be sourced from in-country as well as foreign nationals. The Project will have to comply with the labour legislation of both countries, and where there are gaps; it is proposed that the project defaults to international principles (*viz.* AfDB, World Bank and IFC Principles).

Sensitive Receptors

Unemployed jobseekers who are desperate for employment were identified as sensitive receptors in terms of this impact. This includes the unskilled, women and the disabled specifically who may be willing to work for below market wages, in unsafe conditions or too long hours.

In particular, the ZRA has a Health and Safety Policy which stipulates the Safety, Health and Environmental (SHE) Management System that will have to apply and which calls for:

- Safe and healthy working conditions;
- Arrangements for the operation, design and maintenance of safe systems for work;
- Proper maintenance of machinery;
- Information, instruction, training and supervision appropriate to the project proponent's activities; and
- Arrangement for consultation with employees and their representation on health and safety matters.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impacts related to exposure of the workforce to unfair or unsafe working conditions will be a **Moderate** to **a Major Impact** pre-mitigation (refer to *Table 9.21*).

Table 9.21 Rating Impacts of unfair or unsafe working conditions (Pre-Mitigation)

Type of Impact		
Direct, In-direct, Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local to Regional	The impact is only relevant for the Kariba Dam Rehabilitation workforce they may come from elsewhere in Zambia and Zimbabwe.
Duration	Long-term	Without mitigation and management measures the impact may continue for the duration of the Project. Severe consequences of the impact will potentially result in permanent impacts.
Scale	Small to Medium	Depending on the type of health and safety incident experienced changes to quality of life may substantial.
Frequency	Intermittent	Impact is likely to recur / occur intermittently and potentially for prolonged periods of time if management measures are not implemented and monitored.
Likelihood	Likely	Impact is likely to recur / occur intermittently and potentially for prolonged periods of time if management measures are not implemented and monitored.
Magnitude		
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Medium Sensitivity		
The receptors are all project employees and contractors and sub-contractors with a limited understanding of national labour laws and international good practise in terms of conditions of employment.		

Significant Rating Before Mitigation
Moderate Negative Impact

Mitigation/Management Measures

To ensure adequate mitigation measures for the protection of workers it is proposed that:

- An assessment of the adequacy of the proposed human resource practices and policies of prospective Engineers and Contractors as part of the tender evaluation process.
- Employers (inclusive of Project Proponent, Consulting Engineer and Contractor) should adhere to in-country legislation for workers' working conditions, living conditions and occupational health and safety. Non-compliance with legislative requirements should result in penalties, the form of which should be determined by the Project Proponent.
- The Project Proponent, Engineer and Contractor should have a robust Grievance Policy and Procedure available to employees so that unfair and possible unsafe practices are reported and investigated.
- Monthly and cumulative grievance and safety statistics reports should be prepared, submitted and discussed with the Project Proponent.
- An annual audit of grievance and safety statistics should be conducted.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impacts to unfair or unsafe working conditions will be a **Minor Negative Impact** post-mitigation (refer to *Table 9.22*).

Table 9.22 Rating of residual impacts regarding unfair and unsafe working conditions (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local to Regional	The impact is only relevant for the Kariba Dam Rehabilitation workforce they may come from elsewhere in Zambia and Zimbabwe.
Duration	Short-term	The impact is less likely to have a long-term / permanent impact if mitigation measures are implemented, however exposure will be due to a short term failure in management measures.
Scale	Small	A potential reduction in the number of employees that are exposed / experience the impact throughout the life of the Project.
Frequency	Rare	Decline in the frequency of the impact occurring from recurrent to rare.

Likelihood	Unlikely	Impact is unlikely to occur for prolonged periods should management measures be implemented.
Magnitude		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		

9.3.6 *Increased Incidence of Sexually Transmitted Infections (STIs) including HIV/AIDS*

Description of Baseline Environment

The prevalence of HIV/Aids is slightly lower in Zambia compared to Zimbabwe at 13 percent and 15 percent respectively. It is reported that condom use as a means of HIV/Aids prevention as well as comprehensive knowledge of HIV/Aids is lower in Zambia than in Zimbabwe.

In the Mashonaland Province of Zimbabwe, the top five causes of mortality (amongst others) is HIV/AIDS. In the Southern Province of Zambia, HIV/Aids infection rate is estimated at 14.5 percent. Of those with HIV/Aids, 17.4 percent receive antiretroviral treatment.

The population between 15 and 24 years remains at a higher risk than other age groups to be infected with HIV/AIDs.

Proposed Project Activities

The proposed Project has the potential to increase the transmission of HIV and other STIs in the social AOI due to the following:

- Transport drivers, who may typically have higher rates of HIV or STIs than the general population, may engage in casual sexual activity at their end destination, acting as a vector for the disease.
- A mainly male workforce with a comparatively larger disposable income may engage in sexual activities in local communities, acting as a vector for the disease.
- Existing stigma and taboos around STIs and HIV will make it challenging to negotiate safe sex practices such as the use of condoms (including the use of female condoms).

Any increase in the prevalence of HIV or STIs in the SSA is a business risk for the proposed Project and may affect the health of the workforce and therefore their ability to do their job. There is little access to treatment for STIs in the social AOI; as such, these could also impact the long term health of those who suffer infections. The stigma and taboos around STIs may also affect people accessing treatment in a timely manner which may affect health outcomes.

Sensitive Receptors

Women, young children, the elderly, those infected with sexually transmitted infections and their carers will be most vulnerable to increased transmission of HIV or STIs. The vulnerability in women will be linked to the potential of being infected by their partners and potentially passing the diseases onto their young children (especially HIV) and/ or having to care for the ill for long time. In turn, the elderly may end up having to care for the young children in case of the parents' severe illnesses and deaths. Those infected by HIV or STIs are likely to endure long term stigmatisation by their peers.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, this impact has been assessed as a **Major Negative Impact** prior to mitigation (refer to *Table 9.23).*

Table 9.23 Rating of Impact related to Increased Incidence of Sexually Transmitted Infections (STIs) including HIV/AIDs (Pre-Mitigation)

Type of Impact		
Direct and Indirect, Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	The transmission STIs and HIV/AIDs has a potential to extend beyond the Project Area given the presence of migrant workers.
Duration	Long-term to Permanent	STIs and HIV/AIDs can take a long time to treat and sometimes require a complete change in lifestyle by those affected and respective carers. These also result in deaths if not treated or managed accordingly.
Scale	Large	A significant degree of change in the affected person will be required; some may not be able to provide for their households while other people will require additional care.
Frequency	Intermittent	The frequency of the impact will depend on multiple factors. For instance impacts related to vector borne diseases can recur if certain changes in lifestyle are not undertaken.
Magnitude		
Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
High Sensitivity		
It will take a long time for people affected by STIs and HIV/AIDs to recover. This will not only affect those infected but it will also put a strain on those providing care to them; with a possibility of the carers also contracting the disease themselves.		
Significant Rating Before Mitigation		
Major Negative Impact		

Mitigation/Management Measures

As a means to mitigate impacts related to the increased incidences of HIV/AIDS and other STIs:

- In partnership with local health officials and relevant NGOs, Contractors should undertake information, education and communication campaigns around safe sexual practices and transmission of STIs and HIV/AIDS.

- Contractors should engage with an independent entity such as an NGO to develop and implement an HIV/AIDS Prevention Programmes for its workforce. The NGOs mandate shall cover the workers and communities in the Project Area. The key elements of the workforce and community HIV/AIDS prevention programme are presented in *Box 9.1* below.

Box 9.1 ***Key Elements of a Workforce HIV/AIDS Prevention Programme***

Prevention:

- Raise awareness (address the facts and fiction of HIV transmission);
- Get the message out (make use of local languages or non-written forms of communication);
- Go beyond the workplace;
- De-stigmatise the disease;
- Peer education (train and support peer educators);
- Review occupational health and safety procedures;
- Condom distribution;
- Circumcision promotion;
- Voluntary HIV testing and counselling;
- Post exposure prophylaxis programme for all employees with potential exposure to blood or body fluids;
- Prevention of Mother-to-Child Transmission; and
- Training of managers and supervisors - to improve programme success.

Treatment and Care:

- Anti-Retroviral Treatment (ARV);
- ARV programme for family members infected;
- Adherence promotion;
- Preparation for treatment;
- Controlled dispensing of medication;
- On-going adherence monitoring promotion;
- Provision of nutritional programme; and
- Terminal and home-based care.

- ZRA should develop and implement a Workforce Code of Conduct for appointed Contractors. The key health and safety elements of the code should include:

  - Zero tolerance of illegal activities by all personnel;
  - Forbidding the use of prostitution;
  - Forbidding the illegal sale or purchase of alcohol;
  - Forbidding the sale, purchase or consumption of drugs; and
  - Forbidding gambling and fighting.

- The Workforce Code of Conduct should be adhered to by all Contractors. Any Contractor found in violation of the Code should face disciplinary hearing which should potentially result in dismissal.

- Contractors should ensure that they have sufficient capacity and capability to care and treat any HIV-positive employees.

- Contractors should ensure there is access to free condoms (including female condoms) at the worker camp to promote safe sexual practices.

- In partnership with local authorities and relevant NGOs Contractors should support women's empowerment and education programmes to promote women's rights and safe sexual practices (including the use of condoms and female condoms) and support.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact will be assesses as a **Minor to Moderate Negative Impact** (refer to *Table 9.24*).

Table 9.24 Rating of Impact related to Increased Incidence of Sexually Transmitted Infections (STIs) including HIV/AIDs (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Regional	The transmission of STIs and HIV/AIDs has a potential to extend beyond the Project Area given the presence of migrant workers.
Duration	Long-term to Permanent	STIs and HIV/AIDs can take a long time to treat and sometimes require a complete change in lifestyle by those affected and respective carers. These also result in deaths if not treated or managed accordingly.
Scale	Medium	A significant degree of change in the affected person will be required; some may not be able to provide for their households while other people will require additional care
Frequency	Intermittent	The frequency of the impact will depend on multiple factors. For instance impacts related to vector borne diseases can recur if certain changes in lifestyle are not undertaken.
Magnitude		
Medium Magnitude		
Significant Rating After Mitigation		
Minor to Moderate Negative Impact		

9.3.7 Increased Risk of Road Traffic Accidents

Description of the Baseline Environment

The AoI has mixed land use patterns of rural and urban, with concentrations of people in Siavonga and Kariba. Most of the road network in the AoI is paved. The main traffic sources are public transport and private vehicles (both of local people as well as tourists).

Proposed Project Activities

The plunge pool site will be accessed from the existing M15 national road, situated on the north bank of the river as well as via an existing paved road from the M15 to the turbine outlets on the north bank. To facilitate rehabilitation works, a new road (100m long and 10m wide) will be constructed from the turbine outlets to the north bank powerhouse.

Rehabilitation works will result in increased traffic, particularly heavy traffic. Material excavated (waste rock) from the plunge pool will have to be hauled to the disused Sinohydro Quarry Site where it will be dumped permanently. The quarry is located on the north bank, approximately 3.5km from the plunge pool in a downstream direction and will be accessed via a 1km adjoining road strip and then directly onto the M15.

Construction equipment and materials will also have to be hauled in to the Project site. (The haul route from South Africa to town of Kariba does not form part of this ESIA).

Although the number and size of construction material loads are unknown, it is expected that heavy traffic will increase for the duration of rehabilitation works.

Sensitive Receptors

All road users in the AoI are considered to be sensitive receptors to expected increases in construction traffic. This includes livestock, pedestrians, cyclists, motorcyclists and motorists.

Receptor sensitivity is considered to be medium as there is a general awareness regarding personal safety on the road; however, there is a lack of adequate health care facilities that will be able deal with traffic trauma cases.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is anticipated that the impact of increased risk of road traffic accidents will be a **Moderate** to **Major Negative Impact** pre-mitigation (refer to *Table 9.25*).

Table 9.25 Rating of increased risk of Road Traffic Accidents (Pre-Mitigation)

Type of Impact		
Direct and Indirect Negative Impact		
Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The transportation of workers, goods, materials and equipment to and from site is considered local. As is the transport of spoil material to the quarry.
Duration	Medium term	The potential of this impact occurring will remain for the duration of rehabilitation works. It is expected to be more intensive during rehabilitation of the plunge pool due to the moving of spoil materials from the excavation.
Scale	Residents in the AOI	Residents near or along transport routes will be primarily at risk, while residents in the greater area may experience potential impacts on their safety.
Frequency	Intermittent	The impact will be experienced during specific times of high high traffic flow (i.e. at the beginning of the project when materials are transported through to site and during plunge pool rehabilitation).
Likelihood	Possible	The risk of traffic accidents is possible.
Magnitude		
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		

Medium to High Sensitivity
Receptor sensitivity is considered to be medium as there is a general awareness regarding personal safety on the road; however, there is a lack of adequate health care facilities that will be able deal with traffic trauma cases.
Significant Rating Before Mitigation
Moderate to Major Negative Impact

Mitigation/Management Measures

The Project Proponent should request that vehicle and traffic management procedures be adhered to. Procedures should become compulsory for all Project service providers to adhere to. These procedures should include the following mitigation measures:

- Fitting all Project vehicles with tracking devices capable of checking vehicle speeds and routes followed. Should drivers not adhere to agreed speed limits and approved routes, disciplinary measures should be implemented according to an agreed system.
- Project vehicles should be subjected to regular maintenance checks and maintained in a safe operating condition.
- Definition of safe operating speeds for loaded and empty haulage vehicles should be specified, particularly on public roads.
- Prohibition of unauthorized passenger transport. No members of the public should be transported in any Project vehicles.
- Alcohol and drug use should be prohibited immediately before and during the use of Project vehicles.
- The use of cellular telephones whilst driving Project vehicles should be prohibited.
- Where necessary public roads used as part of the Project should be upgraded and maintained as necessary in the interest of safety.
- Clear signage and signals should be installed on-site and along main haul roads.
- The transport of oversize loads should be restricted to non-peak periods where possible.
- Necessary approvals for the transport of oversize loads should obtained from the relevant authorities prior to the transporting of loads.

In addition to vehicle and traffic management procedures, the following mitigation measures should also be undertaken:

- The development and implementation of a Grievance Mechanism whereby members of the public can raise traffic related incidences and grievances for management by the Project Authorities.

- The development and implementation of Damage Compensation Policy and Procedure in the event that traffic accidents lead to injury and death as a result of negligence on the part of the Project.

- Permitting approval of abnormal loads to be agreed in advance with the relevant authorities.

Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact related to increased road traffic accidents will be **Minor Negative Impact** post-mitigation (refer to *Table 9.26*).

Table 9.26 Rating of Residual Impacts Related to Increased Road Traffic Accidents (Post-Mitigation)

Rating of Impacts		
Characteristic	**Designation**	**Summary of Reasoning**
Extent	Local	The transportation of workers, goods, materials and equipment to and from site is considered local. As is the transport of spoil material to the quarry.
Duration	Medium term	The potential of this impact occurring will remain for the duration of rehabilitation works. It is expected to be more intensive during rehabilitation of the plunge pool due to the moving of spoil materials from the excavation.
Scale	Residents in the AOI	Residents near or along transport routes will be primarily at risk, while residents in the greater area may experience potential impacts on their safety.
Frequency	Infrequent	With the implementation of mitigation/management measures described in this *Section* such accidents will be infrequent.
Likelihood	Unlikely	The risk of traffic accidents becomes less likely to occur should the aforementioned mitigation/management measures be implemented.
Magnitude		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		

9.4 *IMPACTS ASSOCIATED WITH DAM SAFETY*

9.4.1 *Background*

Given that Lake Kariba is the largest man-made reservoir in the world (at 181 x 10^9 m^3), and has a spill capacity of 9,000m^3/s, this Project constitutes a high risk to both downstream inhabitants and the environment in the event of dam failure. The downstream flood plain is currently home to more than 3 million people so potential loss of life could be catastrophic. Other impacts from a dam failure would include loss of livelihoods and loss of power, which will also negatively affect the economies of the region. Kariba Dam and Cahora Bassa Dam account for 40% of the South African Power Pool (SAPP) generation capacity (excluding South Africa).

9.4.2 *Proposed Project Activities*

There are a number of dam safety concerns that are being addressed with the Kariba Dam Rehabilitation Project. These include instability of the plunge pool (foundation undercutting), aging (deterioration of concrete), alkali/ aggregate reaction (concrete swelling), and increased reinforcement in secondary concrete. Also, repairs and refurbishment of the slide gate grooves as well as providing a new emergency closure gate in the event of a spillway gate failure are included in this rehabilitation project.

The primary threats to current dam safety include:

- Undercutting of dam foundations;
- Failure of dam due to lack of foundation support;
- Failure of secondary concrete in u/s slots to carry stop beam loads;
- Loss of ability to close gate upstream;
- Loss of ability to pass floods leading to dam failure if gates fail in closed position; and
- Uncontrolled release of water resulting in loss of power generation due to emptying of reservoir.

Kariba Dam has an eroded plunge pool developed over 20 years of sustained heavy spillage, scouring down to 80m below the normal Top Water Level (TWL). There are concerns regarding its future natural development, for intense spillage with more than 3 (non-adjacent) spillway gates, which may occur in case of exceptional Zambezi floods.

In addition, the spillway is located in the central part of the dam and consists of 6 submerged flood sluices, with the sill 33m below the crest. Flood discharge is controlled by a downstream Caterpillar gate. Each gated section is approximately 9.1m x 8.8m (height x width). The spillway maximum discharge capacity is approximately 9000m^3/s or 1500m^3/s per gate. There is currently no possibility to close one sluice under flow if needed during an emergency. From a dam safety perspective, there is a strong need to provide a means of closure of an opening under flow.

9.4.3 *Potential Impact*

The lack of an emergency response plan for such a project is significant and cannot be understated. If the project fails, SAPP will lose 40% of its entire generation. It would also threaten a population of more than 3 million people downstream. This would substantially impact livelihoods not to mention the significant environmental degradation and loss of flood control on the Zambezi River. According to previous dam break analyses for the Zambezi River, a failure at Kariba could reach an area about 150km away within seven hours. The speed of such a potential flood will require significant preparation and coordination within the emergency response plan in an attempt to minimize the catastrophic impacts to life and property.

9.4.4 *Dam Safety Recommendations*

- The rehabilitation of the Kariba Dam plunge pool and spill way will be carried out in compliance with the OP/BP 4.37 with the Project aimed at ensuring appropriate measures are implemented and sufficient resources provided to ensure the continued safety of the dam. As per OP/BP 4.37 an independent Panel of Experts will be appointed to review the investigations, design, and implementation of the rehabilitation works.

- The overall rehabilitation of the Kariba Dam plunge pool and sluices is inherently a dam safety issue that needs to be carefully considered as part of the overall Kariba Dam Emergency Preparedness Plan (included in the ZRA Kariba Dam and Reservoir Standing Operations Procedure dated Jan 2013). The updating the preparedness plan should be the highest priority. The key to such an update is a well-developed communication plan that has been thoroughly vetted and tested.

- In addition to the above, the ZRA should ensure that the updating of the existing Kariba Dam Emergency Preparedness Plan be done in a way that:

    - The plan is updated in consultation with the relevant stakeholders (stakeholder mapping and identification to be done as part of the updating process).
    - The contact details of those individuals included in the chain of command and communication procedure should be provided in the plan and kept up to date.
    - Downstream communities affected by such an emergency should be identified and contact details for applicable community heads should be provided and kept up to date.
    - Clarifies the need to put a national disaster response mechanism in place for downstream reaches in the event of a catastrophic incident.

- The ZRA have contracted a third party to conduct a comprehensive assessment of the potential consequences of a partial or full dam breach (Dam Break Analysis - DBA) within the Zambezi River Basin (the Terms of

Reference for the DBA are attached to *Annex G* in *Part II* of this ESIA). The specific objectives of the DBA are to:

- Analyse potential flood hydrographs from plausible dam breach scenarios for the existing dams in Zambezi and Kafue rivers;
- Route such floods through the downstream river stretches to assess impacts and potential sub-sequent damage or breach of downstream dams;
- Identify the need for, and carry out, additional detailed topographical surveys for selected river stretches and flood-prone areas; and
- Produce flood inundation maps and characteristics for floods generated through malfunctioned dam operations or dam failures.

The DBA will be used to update the Kariba Dam Emergency Preparedness Plan.

- Copies of the final amended Kariba Dam Emergency Preparedness Plan should be made available to –

    - The Offices of the President
    - The Disaster Management and Mitigation Unit
    - The Civil Protection Unit

- Periodically undertake Kariba Dam emergency preparedness drills to test the emergency plan.

- Currently Kariba Dam is a base load facility. As part of updating the Kariba Dam Emergency Preparedness Plan, the transition of this Project to a modified peaking plant should be evaluated in terms of its potential impact and effect on dam safety.

- The ZRA has acknowledged that they cannot operate all 6 sluice gates without the potential for significant compromise to the dam foundation. The maximum safe operating number is every other gate or a total of 3 gates (4,500m^3/s). The ZRA have also acknowledged that if nothing is done to correct the current gate problems, they would have to reduce their rule curve by 3.5m. If that is the case, they would not be able to justify continued operation under the current rule curve given that the design flood could occur at any time and the Project does not have an emergency preparedness plan to address this current operational limitation.

- It appears that the Tractebel hydrology assumptions/calculations/ estimated impacts have not been updated to include the additional north hydro units or the planned south hydro units. If this is the case, then the anticipated tailwater levels that have been assumed during rehabilitation works would be underestimated. This can either be corrected by operational limits placed on the new units during the time of the rehabilitation Project or revising the proposed downstream cofferdam height so that the potential for additional tailwater height is considered in the design.

- The cofferdam should be addressed in an Emergency Response Plan during the period of the works to ensure protection of the work population as well as possible environmental and social impacts with a failure of the cofferdam. A failure of the cofferdam would be catastrophic to those working on the Project.

- Because of the magnitude and complexity of such a Project and the potential for significant adverse impacts in the event of a failure of the structure, it is strongly recommended that the ZRA retain an independent panel of dam safety experts whose primary purpose is to review the overall project, procedures, progress, operations, and monitoring efforts, throughout the entire period of the work schedule.

9.5 SUMMARY OF IMPACTS AND RESIDUAL IMPACTS

A summary of pre- and post- (residual) mitigation physical and biophysical impacts is provided in *Table 9.27*.

Table 9.27 Summary of Physical and Biophysical Impacts

Impact	Significance (pre-mitigation)	Residual Impact Significance
IMPACTS ON THE PHYSICAL ENVIRONMENT		
Impacts on Hydrology	**Major Negative Impact**	**Negligible Negative Impact**
Impacts on Water Quality	**Moderate Negative Impact**	**Minor Negative Impact**
Impacts on Erosion and Sedimentation	**Minor Negative Impact**	**Negligible Negative Impact**
IMPACTS ON THE BIOPHYSICAL ENVIRONMENT		
Impacts on the Aquatic Environment	**Moderate Negative Impact**	**Minor Negative Impact**
Impacts on Terrestrial Habitat	**Negligible Negative Impact**	**Negligible Negative Impact**
Impacts on Terrestrial Species of Conservation Concern	**Minor Negative Impact**	**Minor Negative Impact**
Impacts on Protected Species	**Moderate Negative Impact**	**Negligible Negative Impact**
IMPACTS ON THE SOCIAL ENVIRONMENT		
Impacts on Tourism	**Negligible Negative Impact**	**Negligible Negative Impact**
Impact on Fisheries-Based Livelihoods	**Negligible to Moderate Negative Impact**	**Minor to Negligible Negative Impact**
Creation of Employment Opportunities	**Positive Impact**	
Procurement of Goods and Services	**Positive Impact**	
Impacts related to Possible Unfair and Unsafe Working Conditions	**Moderate Negative Impact**	**Minor Negative Impact**
Increased Incidence of Sexually Transmitted Infections (STIs) including HIV/AIDs	**Major Negative Impact**	**Minor to Moderate Negative Impact**
Increased Risk of Road Traffic Accidents	**Moderate to Major Negative Impact**	**Minor Negative Impact**

9.6 CUMULATIVE IMPACTS

The IFC Performance Standard 1 (Paragraph 5) defines the broader Project area to include *"… areas potentially impacted by cumulative impacts from further planned development of the Project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken."*

In addition, the IFC Performance Standard 1 (Paragraph 6) states that the *"… assessment will also consider potential trans-boundary effects, such as pollution of air, or use or pollution of international waterways, as well as global impacts, such as the emission of greenhouse gases."*

Cumulative impacts are those impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the proposed Kariba Dam Rehabilitation Project. Cumulative impacts are therefore generally impacts that act with others in such a way that the sum is greater than the parts. This is, however, not always the case – sometimes they will simply be the sum of the parts, but that sum becomes significant.

This *Section* considers the cumulative impacts that would result from the combination of the Kariba Dam Rehabilitation Project and other actual or proposed future developments in the broader area.

9.6.1 Development Context

In addition to the proposed Kariba Dam Rehabilitation Project the broader area may experience cumulative impacts as a result to the following developments:

- The upgrading (extension) of the Kariba North Bank Power Station, which was completed in 2013.
- Upgrading of the Kariba South Bank Power Station, which is currently underway and due to be completed in 2017.
- Ongoing operation of Kariba Dam and associated reservoir management requirements.

PLEASE NOTE:
The assessment that follows is necessarily of a qualitative nature and focuses on key issues and sensitivities, and how these might be influenced by cumulative impacts with other developments in the area.

9.6.2 *Identified Cumulative Impacts*

The cumulative impacts that would result from a combination of the proposed Kariba Dam Rehabilitation Project and other developments in the broader Project Area include:

- Impacts on Surface Water Hydrology and Aquatic Environment;
- Employment;
- Increased Risk of Road Accidents; and
- General Construction Impacts (dust and noise emissions).

Each of these potential cumulative impacts is described below.

Impacts on Surface Water Hydrology and Aquatic Environment

Cumulative impacts affecting the aquatic integrity of the Kariba gorge include the historic construction of the Kariba dam and the associated hydroelectric power stations, both current and proposed, all of which have irreversibly altered the hydrological regime operational within the gorge. Current downstream activities involving the deposition of large volumes of coarse aggregate, resulting in steep unstable slopes which are vulnerable to erosion and threaten the current water qualities through increased turbidity, are likely to further add to the cumulative impacts affecting the receiving aquatic environment. Subsequently, proposed activities directly downstream of the dam involving localized decanting, blasting and potential short-term alteration of existing flow regime, are unlikely to add significantly to the overall cumulative impact affecting the aquatic system downstream of the dam.

Employment

Although development in the AOI provides employment opportunities and contributes to households having more disposable income to contribute to improved livelihoods, it also has the potential to result in unfair and unsafe working conditions (this impact is discussed in *Section 9.3.5* on *Page 9-31*). During in-field engagement with local stakeholders, concerns related to labour and conditions of employment for existing/previous projects (*viz*. the North and South Bank Kariba Power Station extensions) were raised. It was reported that contractors associated with such projects do not adhere to basic conditions of employment as set out in the countries' legislation. Such conditions include low remuneration packages, poor treatment, long working hours, poor workforce accommodation and poor health and safety standards. Should mitigation/management measures included in *Section 9.3* of this *Chapter* be implemented, it is unlikely that the proposed Kariba Dam Rehabilitation Project will add to negative impacts around inadequate labour and poor employment conditions.

Increased Risk of Road Accidents

Baseline vehicle traffic volumes are low in the Project AOI. Existing upgrade works at the Kariba South Bank Power Station and the proposed Kariba Dam Rehabilitation Project will increase light and heavy vehicles using the local roads throughout the duration of works. The combined volumes of road traffic will place both human and livestock in danger of being injured or killed throughout the life of these projects. Close communication and coordination between both project teams and effective signage and traffic management will be required to avoid significant cumulative impacts.

General Construction Impacts (Dust and Noise)

Dust Emissions

Rehabilitation activities associated with the proposed Kariba Dam Rehabilitation Project together with construction activities from other developments have the potential to create negative cumulative impacts associated with the generation of total dust, PM_0 and $PM_{2.5}$. The magnitude of these potential impacts may be minor, moderate or major, depending upon how the impacts from other projects will combine with impacts arising from the proposed Kariba Dam Rehabilitation Project and the respective timing of each project. There will be some overlap of rehabilitation/construction works between the proposed Project and works associated with the upgrading of the Kariba South Bank Power Station, which may result in additional dust generation. This may be worsened by elevated wind speeds, increasing the potential for cumulative impacts during periods of adverse weather. Implementation of dust management actions by both construction projects will be required.

Noise Emissions

As is mentioned previously, there will be some overlap of rehabilitation/construction works between the proposed Project and works associated with the upgrading of the Kariba South Bank Power Station. As such, it is possible that the cumulative noise impact of activities carried for these two projects may result in a nuisance to noise sensitive receptors in the vicinity of the Kariba Dam. This is however dependent on how the impacts from the other development combine with the impacts from the proposed Project, and the respective timing of these impacts.

Blasting Activities and Related Dam Safety

Both the Kariba Dam Rehabilitation Project and the Kariba South Bank Power Station construction activities involve blasting. At this stage it is uncertain if these activities will overlap. If they do, it is possible that the combination of blasting activities from both projects could result in a cumulative impact on dam safety. The Kariba Dam Rehabilitation Project will be carried out in compliance with the OP/BP 4.37 with the project aimed at ensuring appropriate measures are implemented and sufficient resources provided to ensure the continued safety of the dam. As per OP/BP 4.37 an independent Panel of Experts will be appointed to review the investigations, design, and implementation of the rehabilitation works. The Panel should consider the possible cumulative impacts of blasting.

10 CONCLUSION

The Kariba Dam Rehabilitation Works Project is not a scheduled activity under the Zambian and Zimbabwean Environmental Legislation [1]; however, the ZRA has committed to comply with international guidelines and standards, and as such were required to undertake a full ESIA for the Project. In addition to international guidelines and standards, the ESIA has conformed and met the environmental regulatory requirements for both Zambia and Zimbabwe.

The ESIA (this report) is the second and final phase of the overall ESIA process being undertaken in support of the proposed Project, and forms the basis on which the environmental license/approval is issued. The purpose of the ESIA report is to:

- Present a detailed baseline review of the physical, biophysical and social characteristics of the Project Area of Influence and surrounds;
- Assess the impacts (including cumulative impacts) of the physical, biophysical and social environments related with the different phases of the proposed Project; and
- Provide mitigation measures and an associated environmental and social management plan that aims to avoid /minimise/manage the severity of identified impacts.

The ESIA process undertaken has identified and assessed a range of potential environmental and social impacts associated with the proposed Kariba Dam Rehabilitation Project; however, provided that the environmental and social mitigation/management measures provided in this ESIA and associated environmental and social management plan are implemented, the majority of these impacts will be reduced to a minor to negligible level of significance.

Stakeholders will be provided the opportunity to provide feedback on the ESIA report. The broad objectives of stakeholder feedback during the ESIA phase will be to:

- Present the key social and environmental impacts identified in the ESIA report, and proposed mitigation;
- Involve stakeholders in assessing the efficacy and appropriateness of the proposed mitigation measures;
- Capture stakeholder concerns and opinions on the identified impacts; and

(1) Please note that the legislation does list activities associated with the construction of dams; however, not with the rehabilitation/refurbishment of dams.

- Identify revisions or additions to the ESIA report where necessary.

Provided that all the mitigation/management commitments provided in the environmental and social management plan are implemented, it is the opinion of ERM that there are no environmental or social fatal flaws which inhibit authorisation of the proposed Kariba Dam Rehabilitation Project.

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