Mulungushi Hydropower Project – Environmental and Social Impact Assessment (ESIA)

Draft Scoping Report

Lunsemfwa Hydro Power Company Limited (LHPC)

April 2013

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ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome)
ART	Antiretroviral Treatment
BOT	Build Operate and Transfer
CBO	Community Based Organisation
CEC	Copperbelt Energy Corporation
DOE	Department of Energy
DWA	Department of Water Affairs
EA	Environmental Assessments
ECZ	Environmental Council of Zambia
EFA	Environmental Flow Assessment
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
EPCCA	Environmental Protection and Pollution Control Act
EPFIs	Equator Principles Financial Institutions
ERB	Energy Regulation Board
ERM	Environmental Resources Management (Pty) Ltd.
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
FPIs	Framework and Package of Incentives
FSL	Full Supply Level
GDP	Gross Domestic Product
GMA	Game Management Area
GPS	Global Positioning System
GTAs	Gas Turbine Alternators
GWh	Gigawatt Hour
HIV	Human Immunodeficiency Virus
HPP	Hydropower Project
IAP	Impact Assessment and Planning
IFC	International Finance Corporation
IFI	International Finance Institution
IHA SGs	International Hydropower Association Sustainability Guidelines
IPP	Independent Power Producer
ITPC	Itezhi Tezhi Power Corporation Ltd
IUCN	International Union for Conservation of Nature
KNBC	Kariba North Bank Company
KNBEPC	Kariba North Bank Extension Power Company
KWH	Kilowatt Hour
LHCP	Lunsemfwa Hydro Power Company Ltd.
MAP	Mean Annual Precipitation
MEWD	Ministry of Energy and Water Development
ML	Megaliters
MOL	Minimum Operational Level

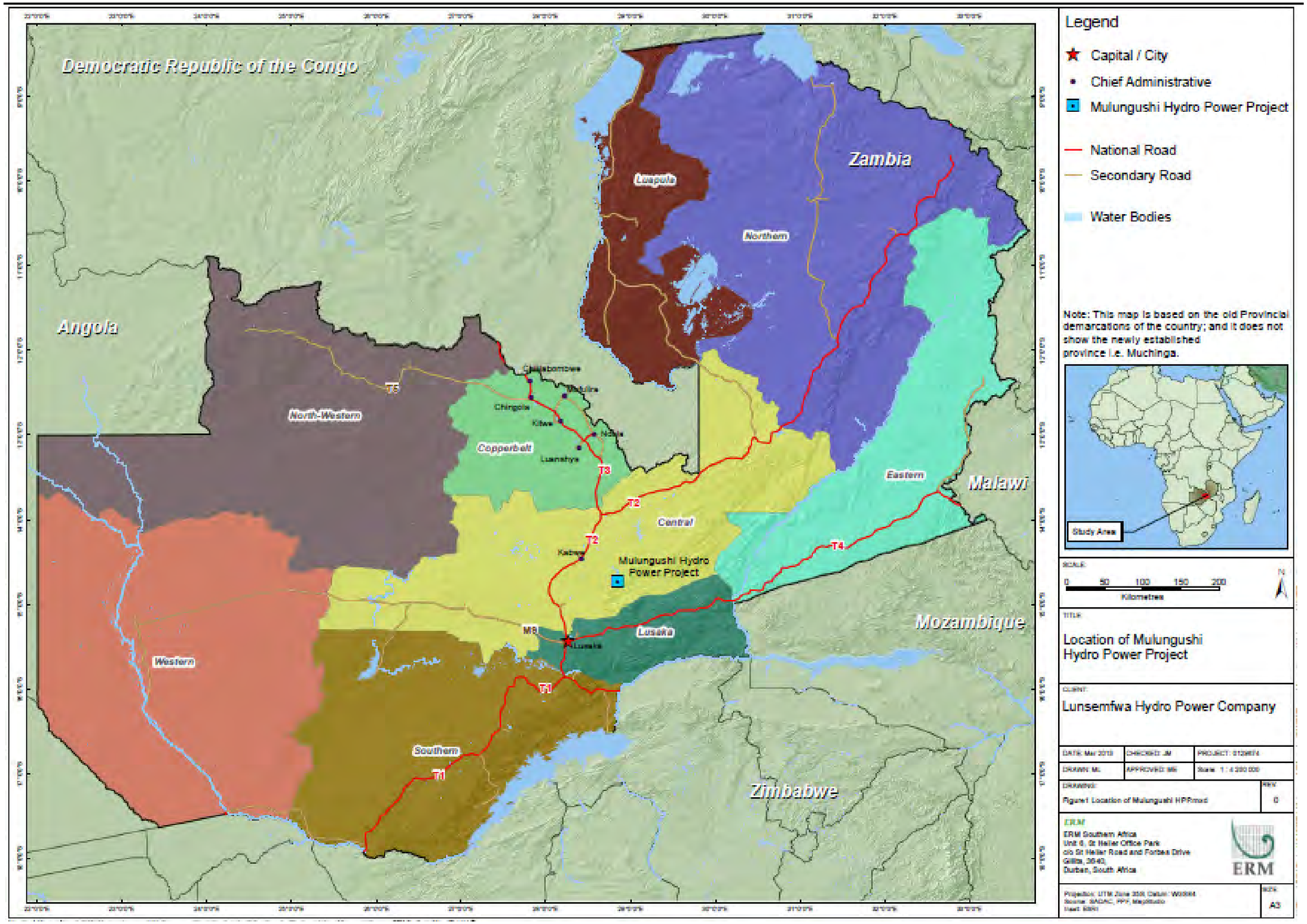
MW	Megawatt
NGOs	Non-Governmental Organisations
NHCC	National Heritage Conservation Commission
NMB	National Museum Board
NTFPs	Non-Timber Forest Products
OPPPI	Office for Promoting Private Power Investment
PCDP	Public Consultation Disclosure Plan
PCR	Public Consultation Report
PTA	Parent Teachers Association
RHC	Rural Health Centre
SADC	Southern African Development Community
SEP	Stakeholder Engagement Plan
SNDP	Sixth National Development Plan
SNEL	*Société Nationale d'Électricité*
SPV	Special Purpose Vehicle
STIs	Sexually Transmitted Infections
TB	Tuberculosis
TDS	Total Dissolved Solids
TTIT	Tourism Training Institute Trust
UNIP	United National Independence Party
WCD	World Commission on Dams
ZCCM	Zambian Consolidated Copper Mines
ZCCM-IH	ZCCM Investment Holdings Plc
ZAWA	Zambia Wildlife Authority
ZEMA	Zambia Environmental Management Agency
ZESCO	Zambian Electricity Supply Corporation
ZTB	Zambia Tourism Board

1. INTRODUCTION

1.1 PROJECT PROPONENT

The Lunsemfwa Hydro Power Company Limited (LHPC), of which Agua Imara AS (formerly SN Power Africa) has a 51 percent stake in, is considering developing a 80-100MW hydropower project (HPP) on the Mulungushi River in the Chimuka and Kapiri Mposhi Districts, located in the Central Province of Zambia, approximately 60km to the south east of Kabwe (*Figure 1.1*). The Mulungushi HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station that will replace the existing but outdated ~30MW Mulungushi hydropower station. The existing Mulungushi Dam will provide the reservoir of water required for the updated Mulungushi HPP, i.e. no new impoundment is necessary.

Figure 1.1 Location of the Mulungushi Hydropower Plant



1.2 *TERMS OF REFERENCE*

Elements of the Project constitute scheduled activities in terms of the Environmental Protection and Pollution Control Act (No. 12 of 1990). As such, an Environmental and Social Impact Assessment (ESIA) is required. In addition to Zambian legal requirements, the ESIA will also need to conform to international standards and good practices, in particular the requirements of the World Bank Group, International Finance Corporation (IFC) and the Equator Principles. The ESIA will also conform with other international guidelines and standards directly applicable to hydropower projects such as the World Commission on Dams (WCD) and the International Hydropower Association (IHA).

Environmental Resources Management Southern Africa (Pty) Ltd. (ERM) was appointed by LHPC to facilitate the environmental licensing process, in accordance with both national and international requirements. Jacob Chishiba, a well-established Zambian environmental management consultant, will provide a review and procedural guidance role, thus ensuring in-country collaboration and regulatory compliance.

1.3 *PURPOSE OF THE PROJECT*

The ESIA process is being conducted in accordance with the Zambian Environmental Management Act (Act No. 12 of 2011), the World Bank Safeguard Policies and the IFC performance standards.

The environmental scoping study (this report – otherwise known as the Terms of Reference for the study) is the first phase of the overall ESIA process. The purpose of the scoping study is to identify the environmental consequences of the proposed project, and to consider input from stakeholders. The study aims to provide the relevant authorities with enough information to make a decision regarding the project, or the need for further biophysical or socio-economic studies. The main objectives of this study are therefore to –

- present the ESIA process and the relevant national legislation and international obligations that will be adhered to;
- present a description of the proposed project;
- present the initial project alternatives and the rationale behind the scoping of certain preferred alternatives that would be carried into the ESIA study;
- present the biophysical and socio-economic conditions of the study area;
- present the issues raised during the initial public consultation;
- identify the environmental and social issues (potential impacts) related with this project, on which the ESIA study will be focused; and
- present an outline of the terms of reference for the various specialist studies that will address the identified environmental and social issues.

The Scoping Report does not present the assessment of the environmental impacts or other definitive outcomes of the study. Rather, these will emerge from the ESIA process and be presented in the ESIA Report.

1.4 AREA OF INFLUENCE

The Project will give rise to three levels of Area of Influence (AoI); namely the Immediate Area of Influence, the Direct Area of Influence and the Indirect Area of Influence, which are described below (*Figure 1.2* and *Figure 1.3*).

Immediate Area of Influence (ie the Study Area) comprises all the land within the LHPC property boundary. It also includes the areas where the new access road and Mulungushi Power House are going to be constructed. All of the Project-related infrastructure forms part of the Immediate Area of Influence.

Direct Area of Influence (ie the Project Area) comprises of:

- The entire length of the road to Kabwe (D421) from the Kasonde village to Musopela village (close to Kabwe town);
- An area of 500m on either side of the D421 road as certain narrow sections of the road will need to be extended to accommodate construction vehicles; and
- Downstream users comprised of the Chembe Chiefdom located approximately 50km downstream from the facility.

Indirect Area of Influence follows the D421 road to Kabwe and is comprised of 1km on each side of the road after the initial 500m (mentioned above as part of the Direct Area of Influence.

Figure 1.2 *Area of Influence (Western Section)*

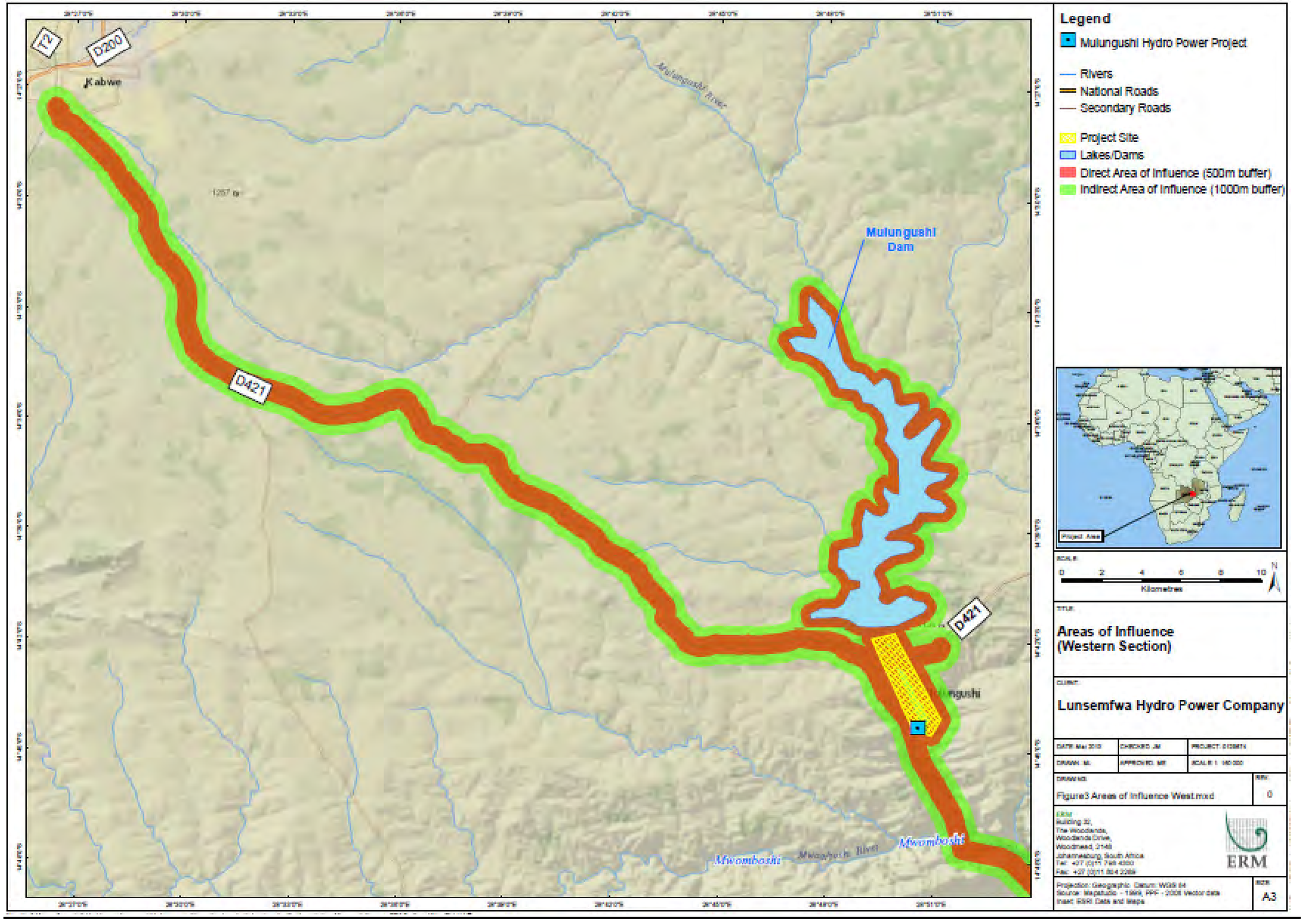
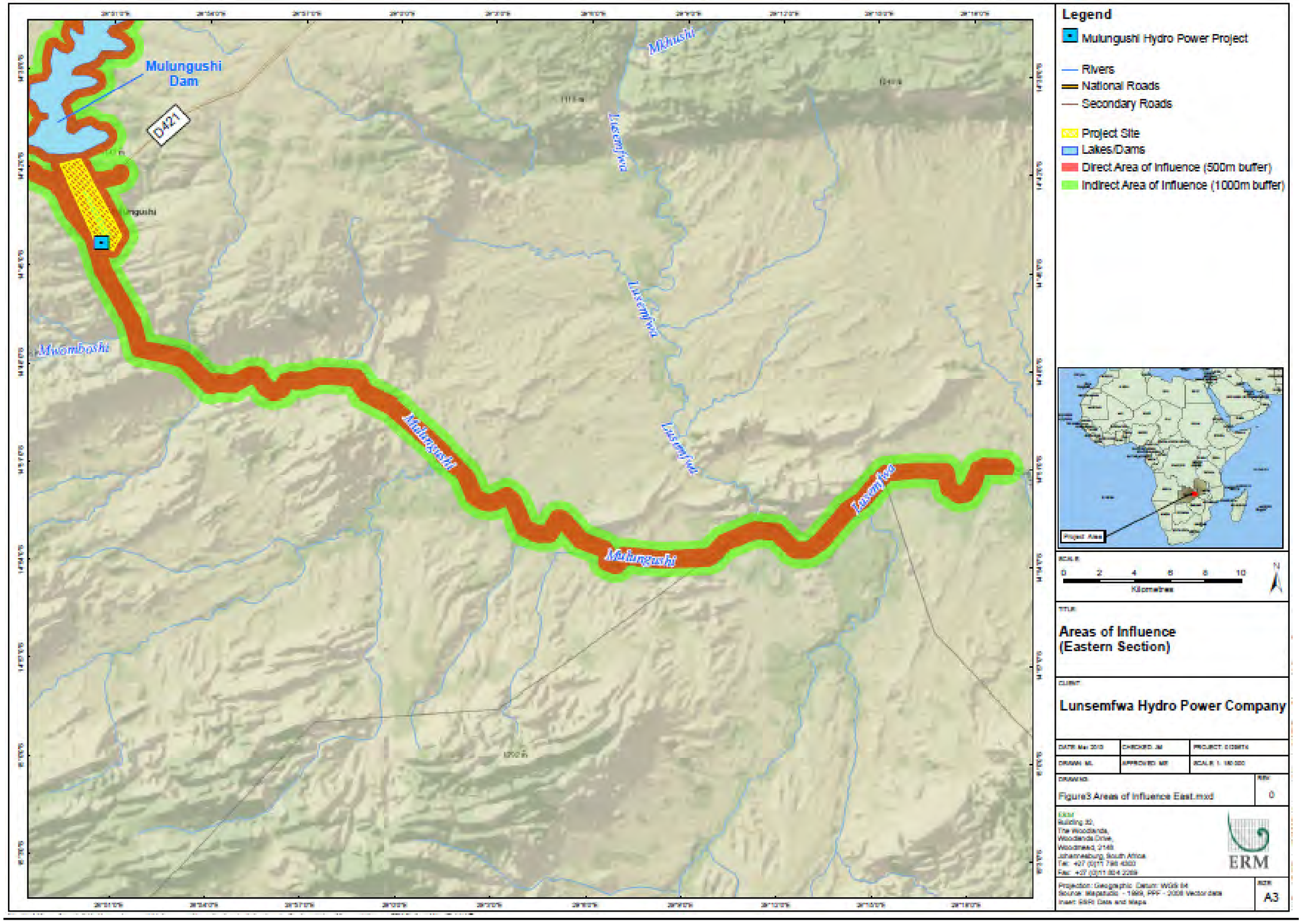


Figure 1.3 Area of Influence (Eastern Section)



2 PROJECT RATIONALE

2.1 ENERGY PRODUCTION AND CONSUMPTION IN ZAMBIA

2.1.1 Energy Production

The public energy utility in Zambia is known as the Zambia Electricity Supply Corporation (ZESCO). Lunsemfwa Hydro Power Company Ltd (LHPC), which operates Lunsemfwa and Mulungushi Hydropower Stations, and the Copperbelt Energy Corporation Plc (CEC), are additional utilities that are responsible for the generation, transmission and distribution of energy to Zambia (CORE, 2004).

ZESCO is a public utility owning the majority of generation, transmission and distribution infrastructure in Zambia. LHPC is a private company and is an Independent Power Producer (IPP). This company runs two hydropower stations with a joint installed capacity of 56MW (31MW from the current Mulungushi Hydropower Station and 25MW from the Lunsemfwa Power Station) (ERB, 2010). ZESCO has a formal agreement with this IPP to purchase all of its generated electricity (CORE, 2004). The LHPC delivered a total of 410GWh in 2011, an increase of 25 percent from 329GWh in 2010(Pers. Comm., 2013). CEC is an electricity utility company operating on the Copperbelt Province of Zambia. The company is privately owned and controls transmission and distribution infrastructure in the Copperbelt Province. In 2008, CEC had an installed capacity of 80MW, although only 26MW of actual generation capacity was utilised. However, in 2010, CEC posted a significant increase in sales output, attributing the positive growth to the increase in mining operations (ERB, 2010). The company's core business involves the supply of power to mines and power transmission for local power producers ZESCO and *Société Nationale d'Électricité* (SNEL) in the Democratic Republic of Congo (ERB, 2008).

Hydropower Stations

The three major Zambian hydropower plants, namely Kariba North Bank, Kafue Gorge, and Victoria Falls, are owned and operated by ZESCO. Furthermore, ZESCO owns and operates four Mini Hydropower Plants. These mini plants include Lusiwasi, Musonda Falls, Chishimba Falls and Lunzua River. These plants were initially developed as power sources for independent power networks in rural areas of Zambia. In the year 2010, major hydropower plants contributed 11, 007GWh of all the electricity generated(ERB, 2010).

Coal Fired Power Stations

Coal accounts for 5 percent of national energy requirements. The largest consumer is the mining industry, followed by the manufacturing sector

(United Nations Development Programme, 2011)[1]. Maamba Collieries Limited is Zambia's largest coal supplier, followed by Collum Coal Mines. Currently Maamba Collieries operates two open cast mines in the Kanzize and Izuma Basins in the Southern Province. However, due to the paralysis of mine operations, the Zambian government transferred its 100 percent stake in the company to ZCCM Investment Holdings Plc (ZCCM). ZCCM is expected to revamp operations at the coal mine and transform it into a viable business entity thus improving coal supply for enhanced industrial production (ERB, 2008).

Diesel Generators

According to the ERB (2010), Diesel Power Plants contributed 14,155MWh in 2010. The following are Diesel Power Stations owned and operated by ZESCO:

- Mwinilunga;
- Kabompo ;
- Zambesi;
- Mufumbwe;
- Kaoma (abandoned due to the area being linked with the National Grid);
- Luangwa;
- Lukulu;
- Chavuma;
- Chama (decommissioned in 2007 after the town was connected to the Malawi grid); and
- Kaputa.

2.1.2 Energy Consumption

The mining sector is currently the largest energy consumer in Zambia, consuming a total of 47 percent of energy produced in 2010. The Services sector is the second largest, consuming 35.5 percent of energy produced in 2010 (ERB, 2010). *Table 2.1* shows the breakdown of sector energy consumption in 2010.

Table 2.1 Breakdown of Energy Consumption by Sector in 2010

Sector	Units Consumed in MWh	Percentage of Total Consumption
Agriculture	193,786	2.5
Construction	9,265	0.1
Energy & Water	90,645	1.2
Finance & Property	338,108	4.3
Others	138,527	1.8
Manufacturing	418,807	5.4
Mining	3,658,113	47.0
Services	2,768,227	35.5

(1) http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/strategic_themes/climate_change/carbon_finance/CDM/zambia_opportunities/ (Accessed 5 March 2013).

Sector	Units Consumed in MWh	Percentage of Total Consumption
Trade	151,894	2.0
Transport	21,470	0.3
Total	**7,788,843**	**100**

Source: ZESCO 2010 Statistics in ERB, 2010.

2.2 *ZAMBIA'S CURRENT ENERGY DEFICIT*

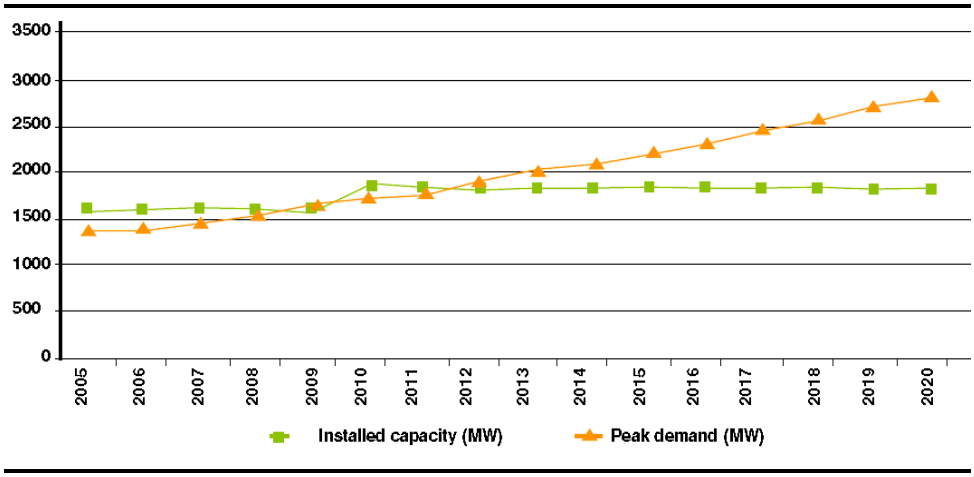
There is evidence of a major power supply deficit in the Southern African Development Community (SADC) and Zambia is no exception (MEWD, 2006 and ERB, 2010). The region has an average annual regional electricity demand growth of about 4.6 percent per annum (ERB, 2010). According to the 2007 Energy Sector Report published by the ERB of Zambia (ERB, 2007), the estimated total installed generation *capacity* in Zambia stood at 1,750MW; of this, only 1,200MW was, however, available on the national grid. During the same period, electricity demand was approximately 1,450MW, indicating a deficit of approximately 250MW (ERB, 2007).

The peak energy supply and demand forecasts (*Figure 2.1*) indicated that post 2011, the power deficit in the country will widen if additional capacity is not installed (ERB, 2008).

The energy deficit in Zambia directly affects this country's economy. According to the Zambian Position Paper on Electricity (2009), this deficit is as a result of poor energy infrastructure and a lack of ongoing rehabilitation. In a quest to improve operations and infrastructure, and in attempting to try and narrow this deficit, ZESCO has made attempts to increase electricity tariffs over the last few years. In addition, increased power deficits have resulted in an increase in the rate of power load shedding. Load shedding, together with increased electricity tariffs, will result in reduced industry production, which in turn will affect company profits, which may quite possibly contribute to unemployment.

Unlike many other SADC countries, in the past Zambia has only experienced a gradual increase in the use of energy for commercial purposes. Between the years 1971 and 2000, the use of energy for commercial purposes has increased by *only* approximately 2 percent (Republic of Zambia, 2006); this has drastically constrained the rate of commercialisation in Zambia.

Figure 2.1 Peak Supply and Demand Forecast without any New Power Plants



Source: ERB, 2008

In addition, during this 29 year time period, the percentage of the population that has had access to electricity has remained at a *constant* 20 percent (Zambian Position Paper on Electricity, 2009). Currently it is estimated that only 25 percent of the population have access to electricity(1) . Those portions of the population that do not have access to electricity derive their sources of energy primarily from wood fuels from Zambian indigenous forests, either as firewood or as charcoal. Although forests comprise over half of Zambia's land cover, the use of wood from forests as a source of energy is a *major* environmental concern. During the period 1990 to 2000, the national forested land cover has *reduced* from 53 percent to 42 percent. This rate of depletion is now currently accelerating (Republic of Zambia, 2006).

2.3 *ELECTRICITY IMPORTS/EXPORTS*

Due to the power deficit that is currently being experienced in the country, ZESCO currently only exports excess off-peak and low voltage power. ZESCO recorded a reduction of 2 percent in electricity exports in 2010, as compared to the major increase of 515 percent in 2009. The 2009 increase is attributable to exports to Namibia following the commissioning of the 220kV transmission line between Victoria Falls and Katima Mulilo (Namibia) via Sesheke.

ZESCO recorded an increase of 30 percent in electricity imports in 2010, as compared to the reduction of 96 percent in 2009 (ERB, 2010).

(1) http://www.erb.org.zm/content.php?viewpage=erips (Accessed 5 March 2013).

2.4 ZAMBIA'S ENERGY DEVELOPMENT GOALS

2.4.1 Vision 2030

Zambia has recently set a vision for the year 2030 (Republic of Zambia, 2006). This vision is to have a strong and dynamic middle-income industrial nation that provides opportunities for improving the well being of all its citizens. Further, the nation aims to have an economy which is competitive, self-sustaining, dynamic and resilient. According to Vision 2030, energy is one of the important driving forces behind the development of the Zambian economy, as it cuts across most economic and social activities (see *Section 5.4* for more detail on Vision 2030).

2.4.2 The Sixth National Development Plan: 2011 – 2015

The Sixth National Development Plan (SNDP) aims to materialise the aspirations of Vision 2030 and contains sector plans that aim to assist in achieving the targets and goals listed in Vision 2030 (Republic of Zambia, 2011) (see *Section 5.4* for more detail on the Sixth National Development Plan: 2011-2015).

2.5 FUTURE INVESTMENT TO MEET POWER OBJECTIVES

Zambia committed to a planned electrification programme to increase access to electricity by at least 10 percent per year over five years from 2006 - 2011 (MEWD, 2006). In order to meet such commitments, a concerted effort to mobilise financial resources was required from both the public (the Zambian Government) and private sectors. The capacity for key implementing institutions such as ZESCO to deal with this requirement is, however, limited. As such, the private sector is key to meeting the commitments of the SNDP (MEWD, 2006).

The Zambian Government has considered establishing a power interchange between other southern African power producers. The ratio of power supply versus demand in other southern African countries is, however, at an equal or worse deficit. Future power developments in these countries are also lagging due to factors such as a lack of funds. In addition, there is a lack of clarity with respect to future prices associated with power interchange, and it is not certain whether a dependence on interchange would be coupled with cost savings. Reliance on power interchange between other southern African power producers therefore entails a high risk (MEWD, 2010).

Fossil fuels used in the generation of electricity include coal- and diesel-fired power stations. The generation of electricity through the use of diesel is not considered economically viable, as the cost of diesel is constantly on the increase (ERB, 2008) and furthermore, fossil fuels are not deemed a sustainable option for future power investment (Rural Electrification Master Plan Study, 2007). As a result, ZESCO is considering replacing diesel power stations with

renewable energy sources such as hydro-power (Rural Electrification Master Plan Study, 2007).

Solar power generation is a renewable option of electrification that is also being considered, especially for isolated rural areas where any connection to the national grid is costly. Currently, solar energy's contribution to improving the electrification rate in Zambia is minor as pilot projects have only recently been set up (Rural Electrification Master Plan Study, 2007).

Hydropower stations in Zambia have recorded a significant increase in generation capacity over the period year 2006 to 2008. Current installed resource capacity is 1,788MW(1); however, resource *potential* is approximately 6,000MW (Vision 2030, 2006). As such, there is *considerable* potential for future hydropower development. In addition, hydropower plants provide a cleaner, more efficient renewable energy source that will potentially enable enough energy generation for national consumption and potentially export. Furthermore, hydropower is able to assist in meeting the goals associated with the reduction in the use of indigenous wood as a fuel for energy.

As a result, the Zambian Government has embarked on a number of hydropower development and refurbishment projects (MEWD, 2006). Some of these developments include:

- ***Itezhi- Tezhi*** - This project is being executed under a Public-Private Partnership on a 50/50 basis between ZESCO and TATA Africa Holdings. A Special Purpose Vehicle (SPV) called Itezhi Tezhi Power Corporation Ltd (ITPC) has since been formed (MEWD, Energy White Paper, 2010).

- ***Kariba North Bank Hydro-Power Station Extension*** - The Kariba North Bank Extension Power Company (KNBEPC) is an SPV wholly owned by ZESCO. The project will increase the existing capacity of the power station by constructing a 360MW peaking plant. The total cost of the project is estimated to be US$420 million. Civil works of the station commenced with 65 percent of the excavations being completed by the end of 2010 (ERB, 2010).

- ***Kafue Gorge Lower Hydro Project*** - The Government of Zambia and the Government of the Peoples' Republic of China signed a Memorandum of Understanding to develop the Kafue Gorge Lower Hydro Project in August 2010. The 750MW power plant is expected to cost about US$1.5 billion (excluding financing costs). The project is being executed through an SPV owned by Sino hydro, China Africa Development Fund (CADFund) and ZESCO Ltd on a Build Operate and Transfer (BOT) basis. The plant is designed as a base load station with an initial installed capacity of 600MW with provision for an additional 150MW during future expansion (ERB, 2010).

(1) http://www.erb.org.zm/content.php?viewpage=erips (Accessed 5 March 2013).

- ***Kabompo Hydro-Power Project*** - CEC is developing the Kabompo hydro power project on the Kabompo River in North Western Province, a 40MW underground power plant. The project cost is estimated to be US$150 million and is estimated to be completed in 2015. Power from Kabompo is intended to be introduced in the CEC system to supplement power from ZESCO. The plant may also be used to operate as a peaking plant, in addition to the existing CEC 80MW Gas Turbine Alternators (GTAs) (ERB, 2010).

- ***Kalungwishi Hydro Power Project*** - At the end of 2008 the Government was expected to finalise negotiations for the project implementation agreement for the construction of this 210MW project. However, such finalisations did not take place due to unforeseen circumstances. The power station will cost US$780 million to develop. It is planned to be built by the Lunzua Power Company, a consortium of local and foreign investors (ERB, 2008). Kalungwishi would mainly supply power to copper mines in Zambia and the eastern parts of the Democratic Republic of Congo (DRC) as well as to the planned Luena sugar plantation in Luapula Province.

- ***Shiwang'andu Mini Hydro Power Project*** **-** Shiwang'andu mini-hydro is a GRZ/UNIDO coordinated project ZESCO is expected to develop. The mini-hydro plant will produce 1MW. Total project cost is estimated at US$ 4.15 million. The contractor, IC-SHP of China, set up temporary site accommodation and offices in May 2010 and a 4km access road has been constructed for mobilization (ERB, 2010).

- ***West Lunga Hydro Power Project*** - This project site is situated in North-western Zambia in Mwinilunga with an estimated capacity of 2.5MW and is estimated to cost approximately US$2.7 million. This project is being spearheaded by the private sector and is at the stage of financing and completing the Power Supply Agreements.

- ***Muchinga Hydro Power Project*** - The Muchinga Power Company Limited (MPC), under Lunsemfwa Hydro Power Company Limited (LHPC), is considering developing a hydropower project on the Lunsemfwa and Mkushi Rivers. The planned total installed capacity of the proposed Muchinga HPP is 255MW.

The government of Zambia has now recognised that attracting private sector participation in the power industry, particularly hydropower, requires an appropriate framework which clearly outlined the concessions and incentives offered. The Framework and Package of Incentives (FPIs) was designed to fulfil this requirement. The FPIs aim to tap into domestic markets to raise financing for power generation and bulk transmission. The main characteristics of the FPIs are:

- Internationally competitive terms;
- Reduction in local currency investment requirements;

- Simplification of procedures; and
- Steps to create and encourage a domestic corporate debt securities market.

This package has been developed in a way that it will provide for a competitive environment comparable with other developing countries seeking private power investment (Minister of Energy and Water Development, 1998). This FPI package together with other liberalisation measures (such as the privatisation of state owned enterprises such as mines), makes Zambia an attractive country for private investment into the power sector.

2.6 CONCLUSION

Investment in energy is a prerequisite to achieving commercial and industrial development in Zambia. The use of solar power is favourable in providing rural areas with access to power; however, if Zambia is to achieve those targets and goals detailed in its Vision 2030 and other complimentary plans, the country will require private sector investment in base-load energy technology that is efficient, sustainable and reliable. The generation of energy through hydropower is a proven technology that is sustainable and which is actively being promoted at a national level in Zambia. With a hydropower energy potential of approximately 6,000MW, hydropower is considered the most feasible and reasonable electrification option for Zambia.

The upgrading of the Mulungushi Hydropower Station as a modernised hydropower facility is thus in accordance with Zambia's national development and sustainability objectives, and is aligned with regional electricity security imperatives.

3 DETAILED DESCRIPTION OF THE PROJECT INDICATING THE VARIOUS PROJECT COMPONENTS

3.1 INTRODUCTION

This *Chapter* provides a general overview of the technical features of the proposed Mulungushi Hydropower Project (Mulungushi HPP), an upgrade of the existing Mulungushi Hydropower Station. The information in this chapter was sourced from the consulting engineers (Lahmeyer International), the *New Mulungushi Hydropower Plant Report* (LHPC, 2013) and on-site field-work undertaken in February 2013.

3.2 PROJECT LOCATION

The proposed Mulungushi HPP is located in the Central Province of Zambia, approximately 60km to the south east of Kabwe (*Figure 3.1*). The Mulungushi HPP, situated in the greater Lunsemfwa Catchment, will be constructed adjacent to the existing Mulungushi Powerhouse, and fed by a 5.4km pressure tunnel directly from the Mulungushi Dam (Alternative 1, see *Chapter 8*). The project is located within the chiefdom areas of Chimuka, Mukonchi and Chembe (*Figure 3.2*). These areas are presided over by chiefs who exercise control over the land tenure of these customary lands.

Figure 3.1 Location of the Mulungushi Hydro Power Project

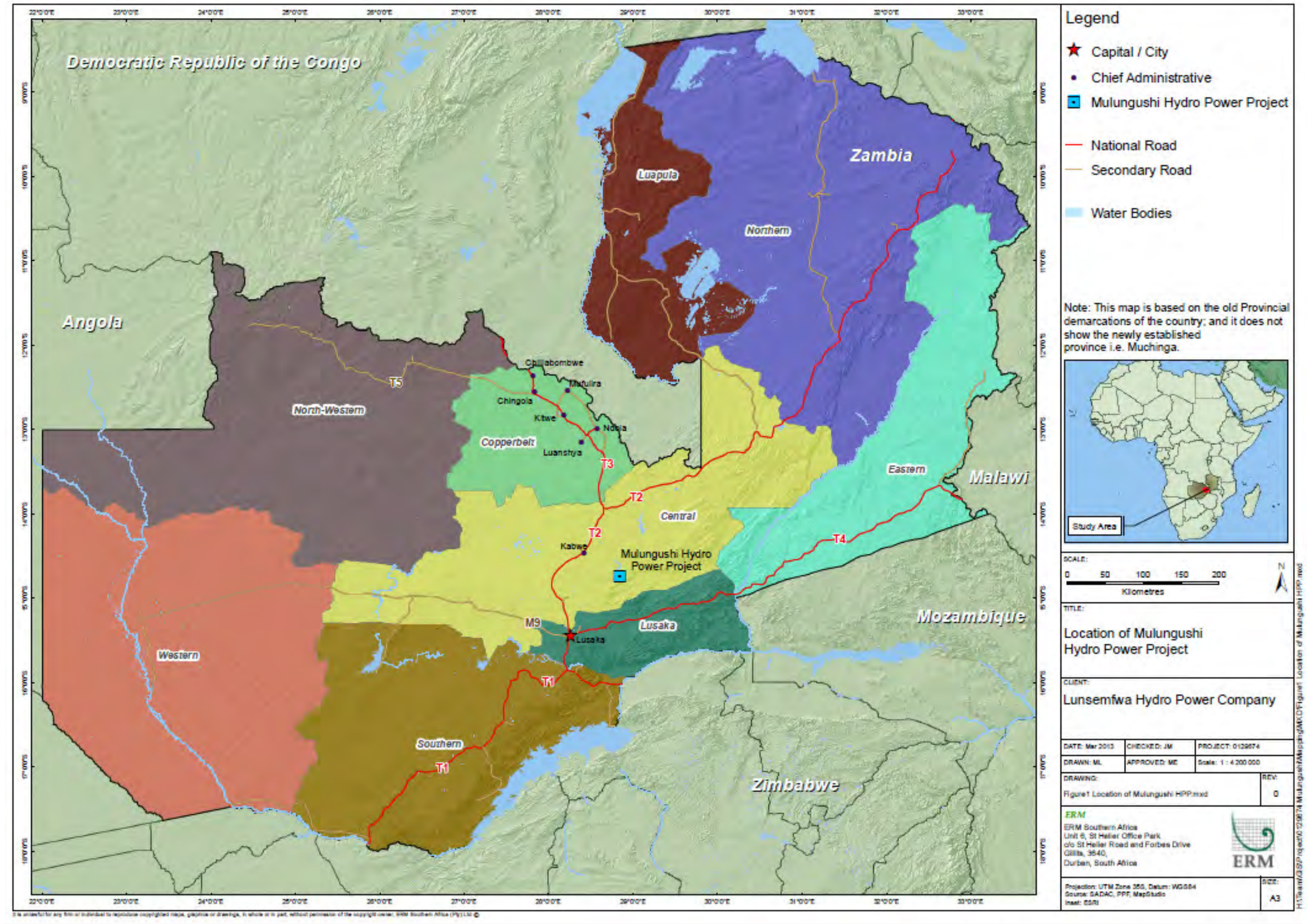
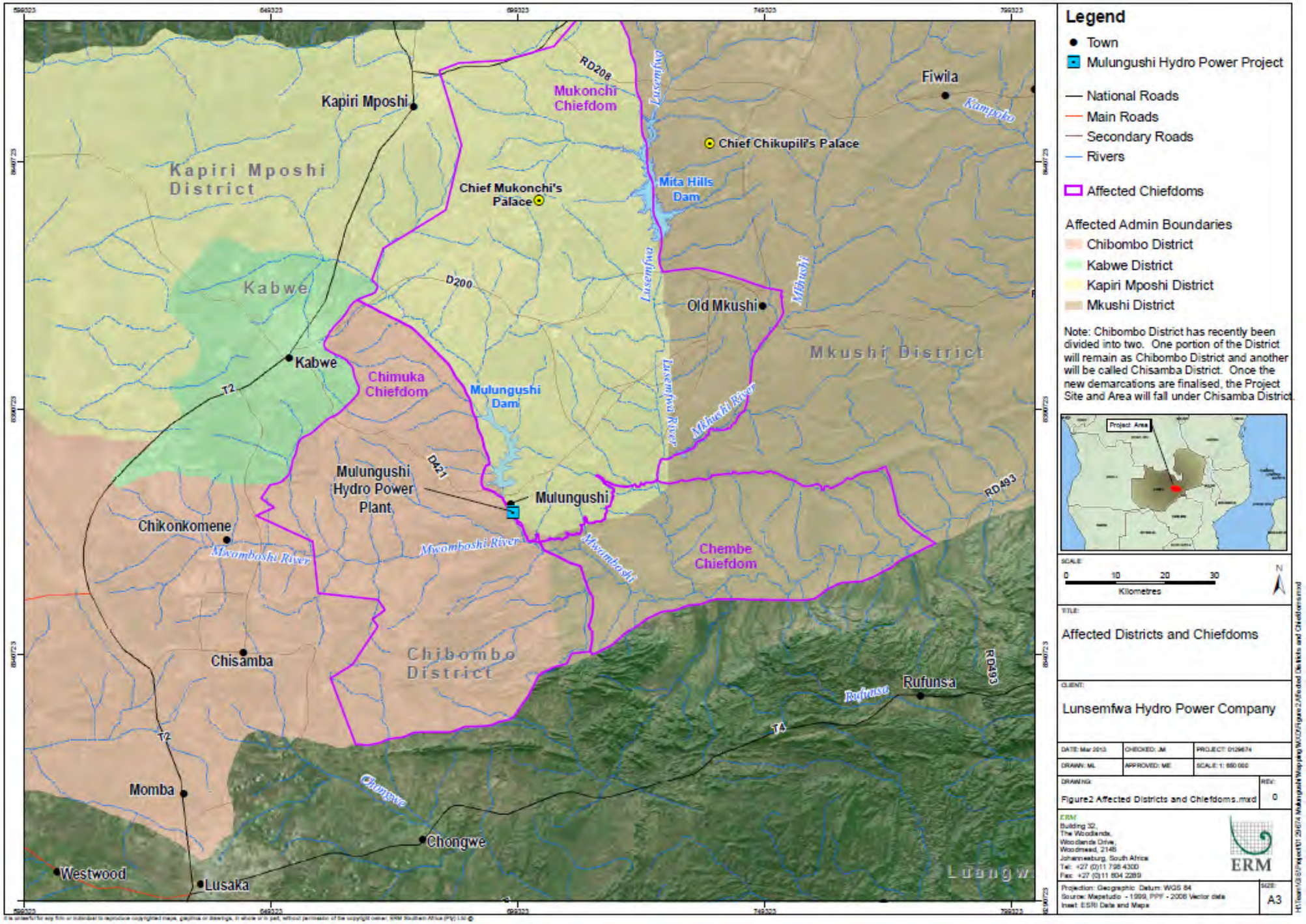


Figure 3.2 *Chiefdoms Boundaries*



3.3 EXISTING MULUNGUSHI POWER STATION

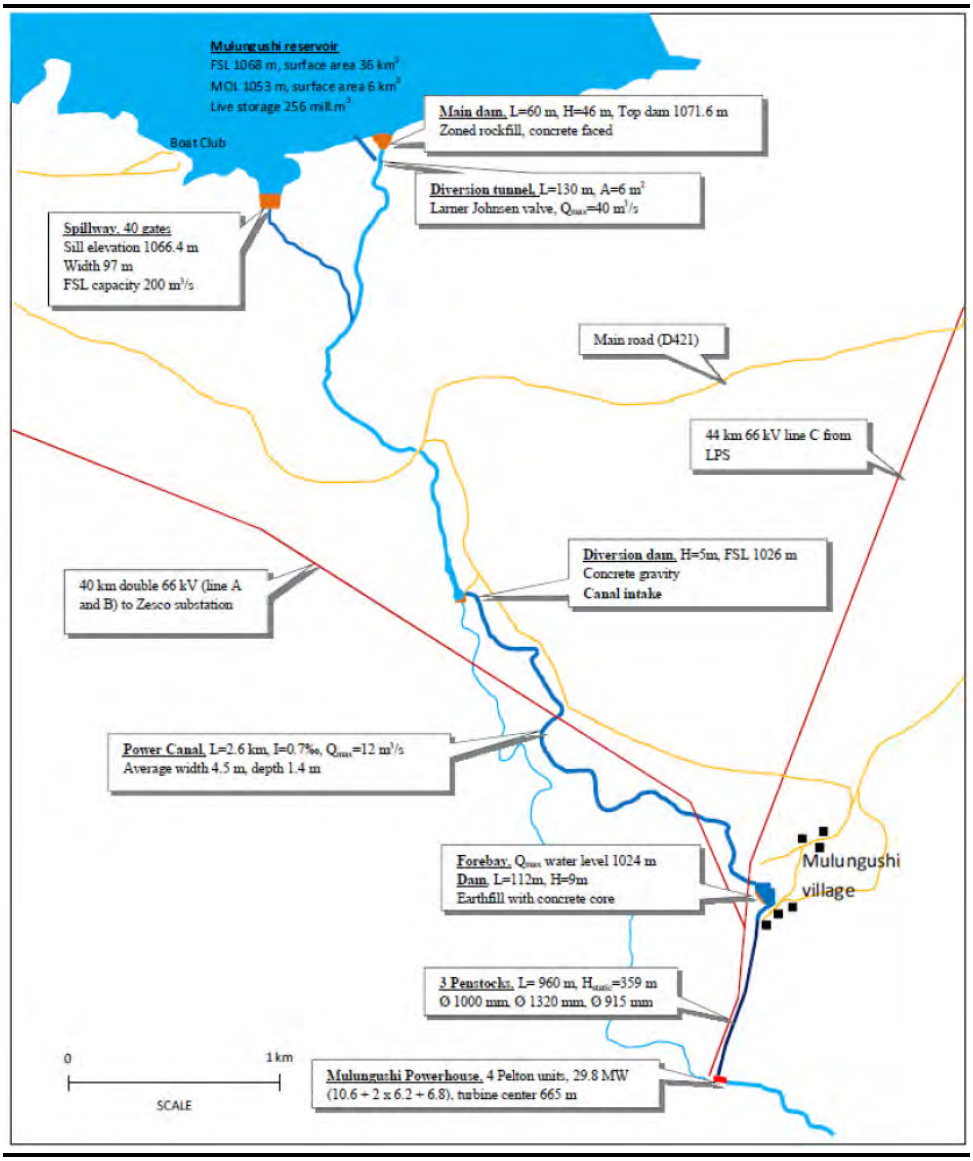
The Mulungushi Dam, a rockfill dam with regulated spillways, was constructed in 1923 and is fed by the Mulungushi River. The dam has a total storage capacity of 272 million m^3, of which 256 million m^3 is live storage. The dam is operated between the Full Supply Level (FSL) of 1068.3 meters above sea level (m.a.s.l) and Minimum Operational Level (MOL) of 1052.7 m.a.s.l which corresponds to a regulation height of 15.5m. The operation of the dam is based on a simple rule curve, which aims at emptying the dam in the middle of December and filling it up by the end of March. *Table 3.1* below shows the main components of the existing Mulungushi hydropower plant.

Construction of the existing Mulungushi Hydropower Station began in 1927, shortly after the completion of the Mulungushi Dam. Initially, two 6.2MW turbines were constructed, and an additional 6.8MW turbine was added in 1944. A switchyard located close to the power house connected it via a 40km double 66kV transmission line to the ZESCO substation at "14-Miles". For safety reasons the penstocks are equipped with closing/shut-off valves at the top inlet and the penstocks pipes need to be exchanged. Due to the age of the existing Mulungushi Hydropower Station, it will be decommissioned in the near future, but only once the Mulungushi HPP has been operational for at least five years.

Table 3.1 General Overview of the Existing Mulungushi HPP

	Type	Unit	Value	Other
Main Dam	Zoned rockfill, concrete faced	Length (m)	60	Top dam (1071.6m)
		Height (m)	46	
Diversion Tunnel	Larner Johnsen	130		Q_{max} = 40m^3/s
Spillway (40 gates)		FLA capacity (m3/s)	200	Sill elevation (1066.4 m)
Diversion Dam (canal intake)	Concrete gravity	FLA capacity (m^3/s)	1026	Q_{max} (12m^3/s)
		Height (m)	5	
Power Canal		2600	1.4	
Forebay		Q_{max} water level (m)	1024	
Forebay Dam	Earthfill with concrete core	Length (m)	112	
		Height (m)	9	
3 Penstocks		Length (m)	960	H_{static} = 359m Ø 1000mm. Ø 1320mm. Ø 915mm.
		Height (m)	359	
Mulungushi Powerhouse	4 Pelton Units	MW	29.8MW (10.6 + 2 x 6.2 + 6.8)	turbine center (665m)

Figure 3.3 Existing Mulungushi Hydropower Station



Source: Lahmeyer International (2013)

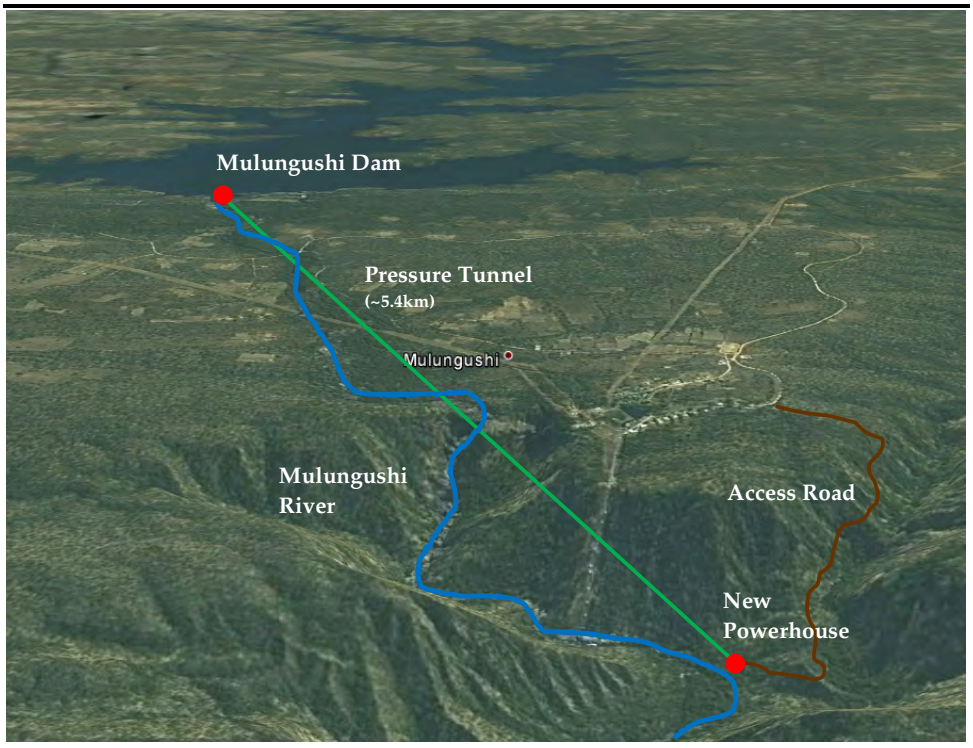
3.4 MULUNGUSHI HPP PROJECT COMPONENTS

The layout of the proposed Mulungushi HPP is provided in *Figure 3.5.* and *Figure 3.45.* The Mulungushi HPP (Alternative 1) was selected from one of four alternatives that were evaluated in terms of their net benefit (input costs relative to their power generation capacity) (see *Chapter 8* for a detailed analysis of the Project alternatives). Compared to the other alternatives, Alternative 1 has the largest net head (distance the water falls), highest average annual energy generation, lowest maintenance costs, and is the alternative with the lowest probability interrupting of power generation from the existing Mulungushi Hydropower Station or allow for a 'discharge unit'.

Construction of the Mulungushi HPP will involve the drilling of a pressure tunnel (approximately 5.4km in length) from the Mulungushi Dam directly to

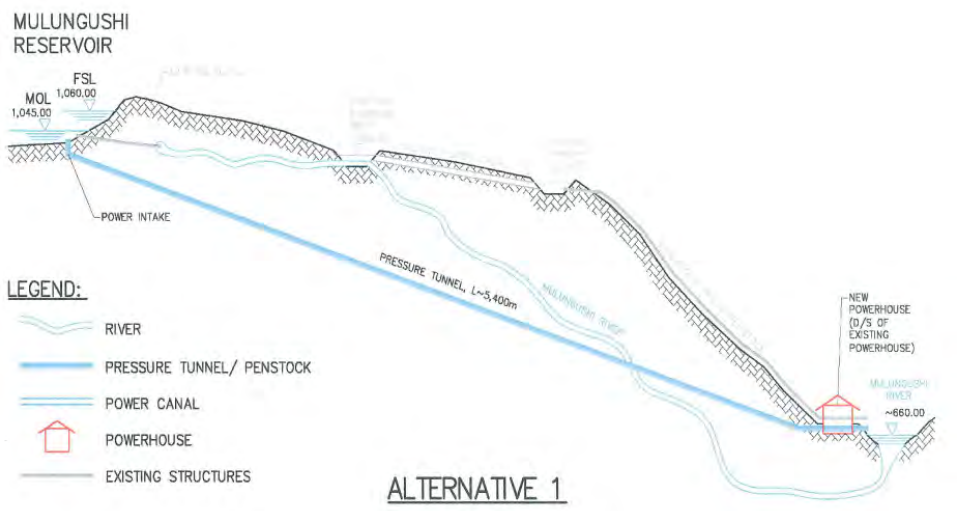
the new Mulungushi Powerhouse which will be built adjacent to the existing Mulungushi Powerhouse (approximately 400m downstream). The pressure tunnel Project alternative was considered viable due to the geology of the Mulungushi Study Area, characterized by a gneiss formation, which is well suited to underground engineering solutions. Water from the Mulungushi Dam will be fed into the pressure tunnel through a power intake that connects the upper end of the pressure tunnel to the Mulungushi Dam. The pressure tunnel drops approximately 385m in elevation from the power intake at the Mulungushi Dam down to the new Mulungushi Powerhouse.

Figure 3.4 ***Generalised Layout of the Mulungushi HPP***



Source: Google Earth (2013)

Figure 3.5 Mulungushi HPP Cross-sectional Layout (Alternative 1)



Source: Lahmeyer International (2013)

Table 3.2 below gives the main components of the Mulungushi HPP. The new Mulungushi Powerhouse is planned to be a surface facility, compared the alternative underground powerhouse, and will contain two 40-50MW Francis turbines. This powerhouse will be located on the left bank of the Mulungushi River between the existing powerhouse and it's confluence with the Katobo River. The Francis turbines, with a total output capacity of 80-100MW, utilize a slightly larger head, and have a slightly higher efficiency than the considered alternative Pelton turbines, and will, due to the fact that they operate submerged, also utilize a slightly higher head than Pelton turbines.

The Mulungushi HPP will have a higher installed capacity than the existing Mulungushi Hydropower Station, in order to utilize all the water available. For the Mulungushi HHP, a future extraction capacity of about $20m^3/s$ has been estimated. Such flow would lead to a more or less complete dam drawdown in the driest years, with the average spillage estimated to be almost negligible (~1 percent).

The total installed capacity of the Mulungushi HPP will be in excess of the capacity of the existing 66kV line to the ZESCO sub-station at "14-Miles". Instead of strengthening the line capacity, the Mulungushi HPP will be connected to the new 330kV transmission line from the Muchinga HPP (located to the east of the Mulugushi HPP) to the "14-Miles" sub-station. This transmission line is planned to pass by Mulungushi along the same route as the existing 66kV line.

A new access road of approximately 4.5km is planned which will link the village of Mulungushi to the new Mulungushi Powerhouse at the bottom of the gorge. An initial road routing, parts of which will be in steep terrain, has been determined.

Table 3.2 Principle Characteristics and Components of the Mulungushi HPP

Project Facility	Description
Power Intake	
Coordinates	8,374,601 N 696,707 E
Type of power intake	Cylindrical steel tower with radial inflow
Intake height m.a.s.l	Foundation level: 1036m
Small Power Unit	
Small power unit at tunnel discharge	6MW
Pressure Tunnel	
Coordinates of entrance	8,374,439 N 696,775 E (intake gate shaft)
Height of pressure tunnel intake	Centerline of tunnel at intake gate shaft: 1003m
Length	~5.4km
Diameter	4.90m
Drop in altitude from Power Intake to Powerhouse	~385m
Angle of Pressure Tunnel	From upstream to downstream: 8.0 percent/ 3.0 percent/ 10.7 percent/ 1.5 percent
Location and footprint of tunneling spoil	Flat unused land near the adits.
Powerhouse	
Coordinates	8,369,575 N 698,757 E
Type	Surface
Number of turbines	2
Distance from existing Powerhouse	Straight line distance: 380m; distance along river: 410m
Turbines	
Type	Francis
Unit rated capacity	42MW
Total power output (or range)	84MW
Energy	
Annual average energy production	349GWh
Access Road	
Width of Road	5 m carriageway; 1m shoulder on both sides
Length	~4.5km
Type of permanent road	Surfaced: asphalt
Gradient range	Max. 13 percent
Temporary Construction Facilities	
Location/coordinates	At powerhouse site, intake and access adit portal (698,071 N 8,370,906 E)
Footprint	Currently unknown
Temporary Labour Camp	
Location	Unused flat land east of Mulungushi village
Footprint	Currently unknown

Source: Lahmeyer International (2013)

4 BASELINE INFORMATION

This *Chapter* provides a description of the environmental and social baseline of the proposed Mulungushi HPP, focussing on the proposed Project Area, as is described in *Section 1.4*. This baseline is based primarily on a review of available secondary information.

It is important to gain an understanding of the physical, biological and socioeconomic attributes of the Project Area and surrounds, as this will allow for a better understanding of the environment in which the Project is being considered. Consideration of the receiving environment is a prerequisite for the identification of potential environmental and socio-economic impacts.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

The climatic data for the Central Province indicates that there are distinct dry (May to October) and wet (November to April) seasons. Rainfall frequently occurs in heavy thunderstorms producing a range of precipitation events from 20 to 40mm.

Climate data revealed that the annual mean climatic conditions for the Central Province are as follows:

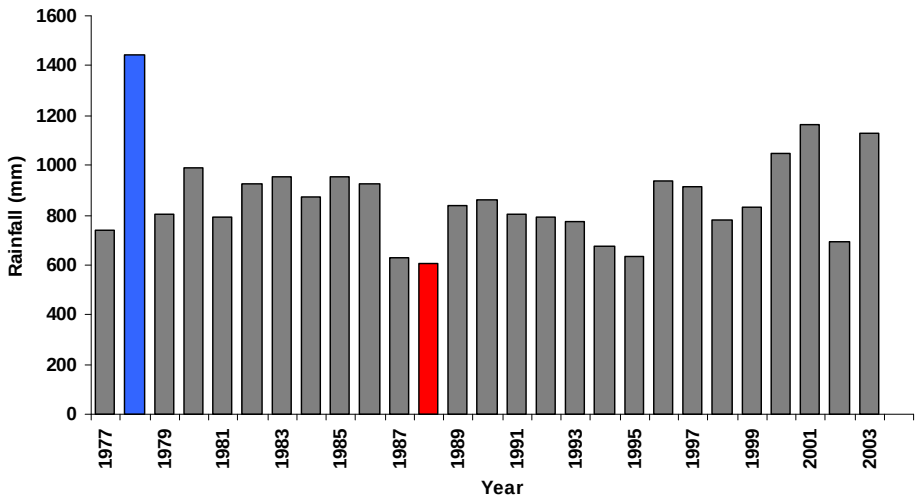
- Mean Annual Temperature during the period 1976-2006 was 20.2°C;
- Mean Annual Precipitation during the period 1977-2004 was 877mm; and
- Mean Annual Wind Speed during the period 1981-2005 was 5.2 knots.

Rainfall and Evaporation

Daily rainfall data for the period 1977 to 2004, obtained from the Kabwe Meteorological Station indicates that the Mean Annual Precipitation (MAP) is 877mm, with the lowest recently recorded annual rainfall being 603mm in 1988 (indicated in red in *Figure 4.1*). The highest recorded MAP was 1,444mm in 1978 (indicated in blue in *Figure 4.1*). The wettest months in the Central Province are December and January.

The average maximum precipitation in Kabwe measured over 24hrs, is 67mm.

Figure 4.1 Total Annual Rainfall (Kabwe Meteorological Station: 1977 to 2004)



Source: AMC (2009)

The daily evaporation rate in the area ranges from 3 to 10mm. In the warmer months (September and October), evaporation reaches a peak of 13mm. The lowest evaporation rates occur in the month of February towards the end of the wet season (AMC, 2009).

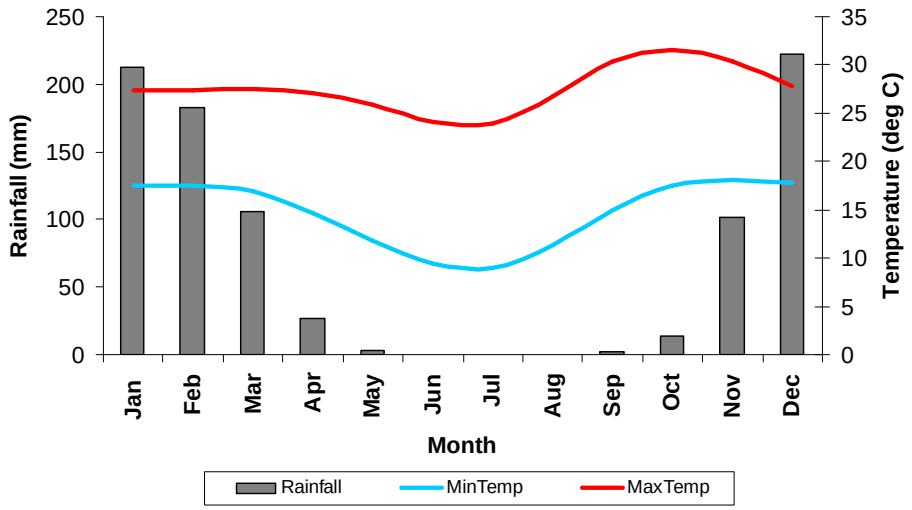
Temperature

Temperatures, like rainfall, are defined by the two seasons, cool and dry (May to September) and warm and wet (October to April) (*Figure 4.2*). Lower temperatures occur during the dry season, with the lowest temperatures occurring in June. The highest temperatures occur in October with the average monthly maximum temperature of 32°C as shown in *Figure 4.2.*

Humidity

Humidity data indicates Mean Annual Humidity in the Province to be between 33 and 59 percent. Mean humidity levels vary from a minimum of 29 percent in the cool dry season to a maximum of 89 percent in the wet season.

Figure 4.2 ***Mean Monthly Rainfall and Temperatures***

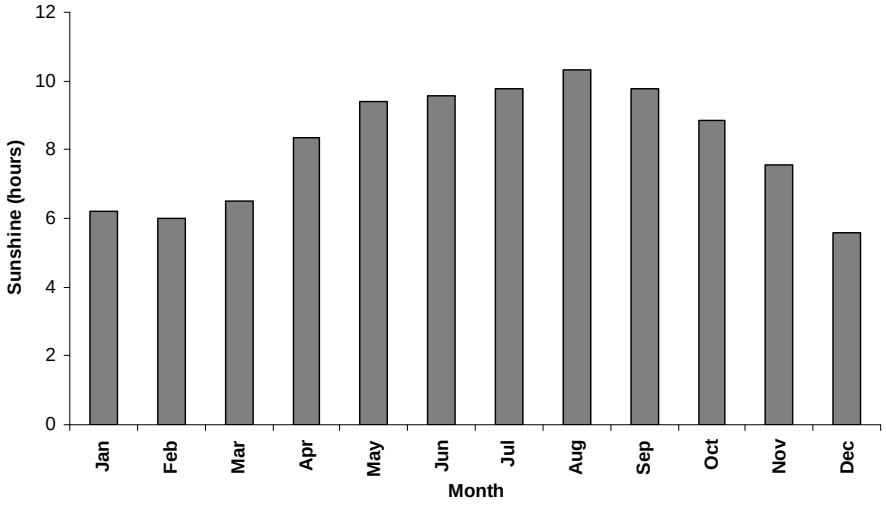


Source: AMC (2009)

Sunshine

Mean Annual Sunshine in the Central Province ranges from approximately 6 to 10 hours per day. There is more sunshine during the dry season than during the wet season (*Figure 4.3*). Sunshine hours decrease from December to March and then start to increase in April and May.

Figure 4.3 ***Mean Annual Sunshine (hours/day) in the Central Province***



Source: AMC (2009)

Wind

The predominant wind directions in the Central Province are from the northeast, east and southeast. During the wet summer months, and particularly during storm activity, wind direction may temporarily shift to the west and northwest.

4.1.2 Air Quality

In general, ambient air quality of any given area is affected by the presence of industry, transport routes and/or agricultural activities. Given the rural nature of the Project Area and the lack of any heavy industry, ambient air quality in the area is expected to be good, with levels of industrial pollutants very likely to be below detection limits. Windblown dust from exposed areas of land and smoke from domestic wood fires are the only likely sources of any emissions to air in the Project Area.

4.1.3 Geology

The Project Area is located in a fold and thrust belt named the Irumide belt, a northeast-trending Mesoproterozoic structural province stretching from central Zambia to the Zambia–Tanzania border and northern Malawi [(1)]. Most of the Mulungushi River Basin (and the initial portion of the Mulungushi Dam) is located in this belt, which is characterised by an undifferentiated basement complex (mainly granitic gneisses and migmatites with some granite).

However, most of the Mulungushi Dam was constructed on two different mixtures of rock type which extend longitudinally into the Irumide belt, with one rock type sandwiched inside the other. The first rock type is composed of metamorphosed pelite, quartzite-pelite and psammite sequences, some of which are associated meta-carbonate and meta-volcanic rocks (also including Chisamba Formations, Mpanshya group, Sasare group and Mwami group). The second type consists of volcanics and meta-volcanics. Most of the rock types in the Project Area are separated by fault lines.

The upstream portion of the Mulungushi HPP is situated at the southern boundary of the first rock type (pelite type). The pressure tunnel, linking the Mulungushi Dam and the new Mulungushi Powerhouse, will extend southward into the Irumide belt which is characterized by a gneiss formation that is well suited to underground solutions.

4.1.4 Soils

The Project Area spans two soil units:

Firstly, the pressure tunnel route from the Mulungushi Dam to Mulungushi village is dominated by a mix of Lithosols, Ferric Acrisols and Ferric Luvisols. These soils are grouped in the “escarpment zone” (Barichievy, 2013).

Lithosols (Leptosols): Are shallow, rocky soils whose profile shows limited pedological development. The soil profile is dominated by weathering rock and/or rock fragments and depth to hard rock is generally less than 5cm from the surface. A distinct lack of rooting depth will lower these soils' Land Use Capability (LUC) scores.

Ferric Acrisols: Iron rich, acidic soils. Acrisols are strongly weathered, acid soils, that have a low cation exchange capacity (CEC) and a low base saturation. In addition, the following soils, which are associated with Acrisols, can be located along the Lunsemfwa mountainous landscapes (Mukalay, 2011):

- ***Ferralsols*** - deeply weathered soils that have low CEC and are virtually devoid of weathered minerals.
- ***Regosols*** - very weakly developed mineral soils in unconsolidated materials.
- ***Leptosols*** - shallow soil over hard rock.
- ***Cambisols*** - soils with the beginning of horizon differentiation evident from changes in colour or structure, young soil on foot slope of mountain.

Ferric Luvisols: Luvisols are soils in which clay has migrated from the upper horizons, to the lower parts of the profile (structure would increase with depth). Provided they have good drainage characteristics, they are suitable for many agricultural uses.

Secondly, the valley area below Mulungushi village is dominated by Chromic/ Pellic Vertisols and Orthic Luvisols. These soils are grouped in the "Rift Valley" zone (Barichievy, 2013).

Chromic / Pellic Vertisols: Vertisols are generally found in bottom lands/ depressions. Vertisols are clay rich soils with strongly developed structure and a high proportion of 2:1 clay smectitic clay minerals. These soils will tend to swell during the wet months and shrink during the dry season, which gives rise to vertical cracks. Due to their extreme physical characteristics vertisols are one of the most problematic soil types from an engineering, agricultural and management perspective.

Orthic Luvisols: Luvisols are described above.

4.1.5 Topography

The Project Area is situated just north of the Muchinga Escarpment, an extension of the Great Rift Valley. The difference in elevation between the crest and toe of this escarpment is approximately 500m. After leaving the Mulungushi Dam, the Mulungushi River flows southward over fairly level ground for approximately 4km, before dropping approximately 350m into a gorge just below the village of

[(1)] SP Consulting Engineers (2010). *Muchinga HPP - Phase I – Feasibility Conceptual Schemes Report.*

Mulungushi. The gorge, approximately 13km in length, was created by the Mulungushi River, which continues southward to the edge of the Muchinga Escarpment. The Mulungushi River is joined from the west by the Mwomboshi River approximately 4km before leaving the Muchinga Escarpment. The Mulungushi River then veers east-southeast for approximately 40km where it joins the Lunsemfwa River.

4.1.6 Hydrology

The proposed Mulungushi HPP is located in the southern portion of the Mulungushi Catchment which drains an area of approximately 4,347km^2. The Mulungushi Catchment falls within the greater Lunsemfwa River Basin (Mott McDonald, 2013).

Mulungushi Catchment

Three gauging stations have been identified within the Mulungushi Catchment. The Mulongo and Muswishi gauging stations are located close to the Mulungushi Dam (see *Figure 4.4*), while the Great North Road gauging station is further upstream. The Mulongo and Muswishi sub catchments have a combined area of 3,900km^2 which constitutes almost 90 percent of the total Mulungushi Catchment (see *Table 4.1*) (Mott McDonald, 2013).

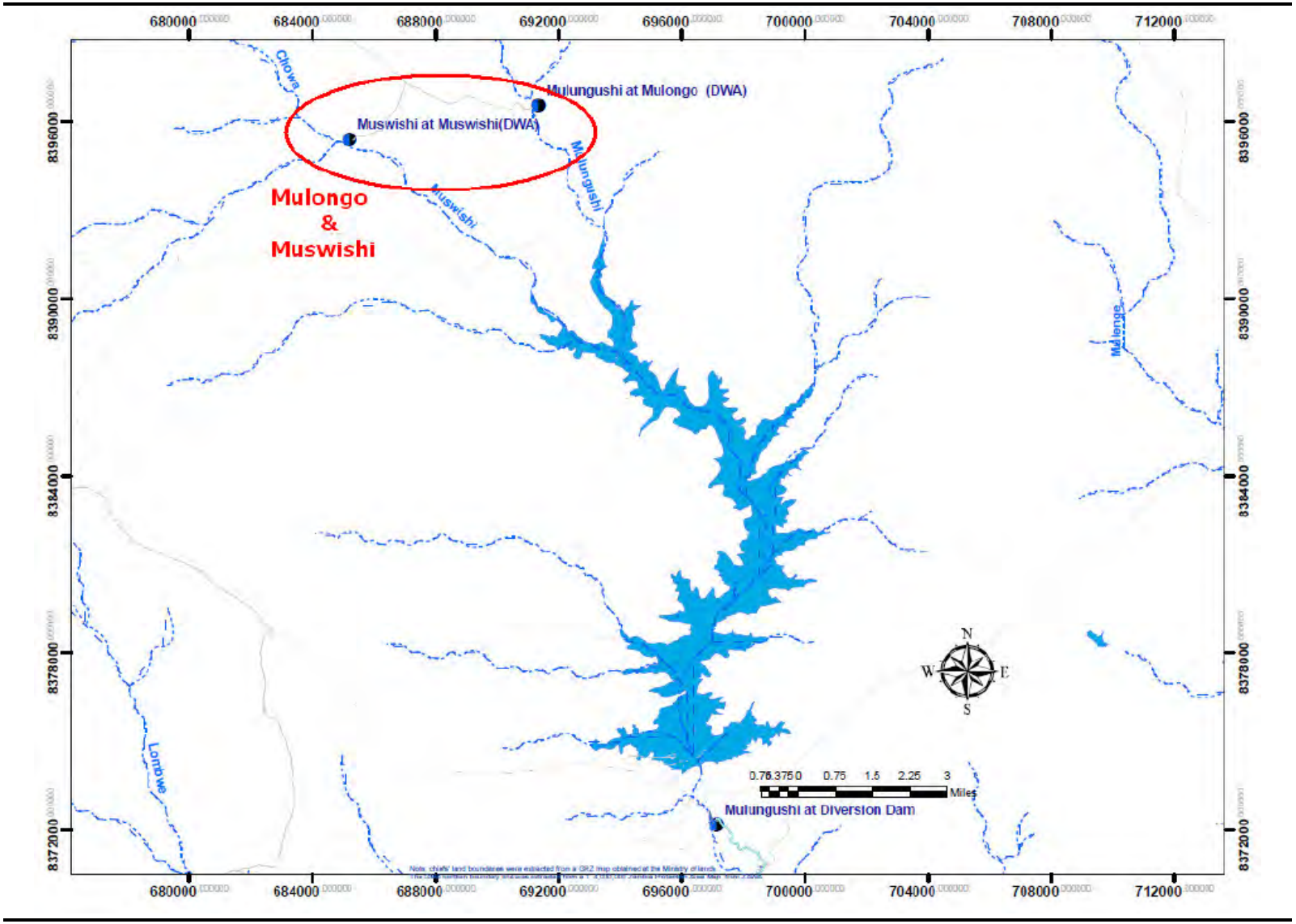
Water levels are manually recorded at the gauging stations, usually three times per day. Daily flow data are available for many years for the Great North Road gauging station, using rating curves derived by the government monitoring organisation. Although the Mulongo and Muswishi gauging stations are newer and do not have official rating curves, there are recent discharge measurements from which ratings could be derived (Mott McDonald, 2013).

Table 4.1 Components of the Mulungushi Catchment

Catchment	Area (km^2)	Percentage Share
Mulongo	3,272	75
Muswishi	628	14
Minor Streams	447	10
Mulungushi Reservoir	4,347	100

Source: Mott McDonald (2013)

Figure 4.4 *Mulongo and Muswishi Gauging Stations*

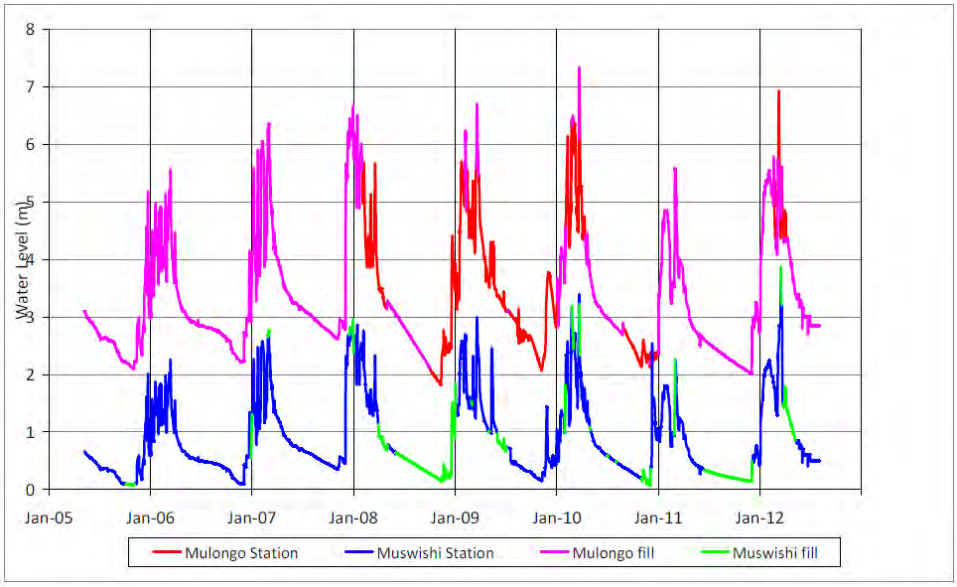


Source: Mott McDonald (2013)

Water Level Data

The daily water level data for Mulongo (January 2008 to September 2012) and Muswishi (May 2005 to September 2012) were plotted. This data from the two gauging stations show similar water level patterns, although both sets of data have periods of missing data. As the two data sets have a reasonable level of agreement, it was possible to infill the Mulongo missing data with estimates from Muswishi (Mott McDonald, 2013). *Figure 4.5* shows the water level time series after the infilling of the missing data.

Figure 4.5 Infilled Water Level Data



Source: Mott McDonald (2013)

Derived Flows

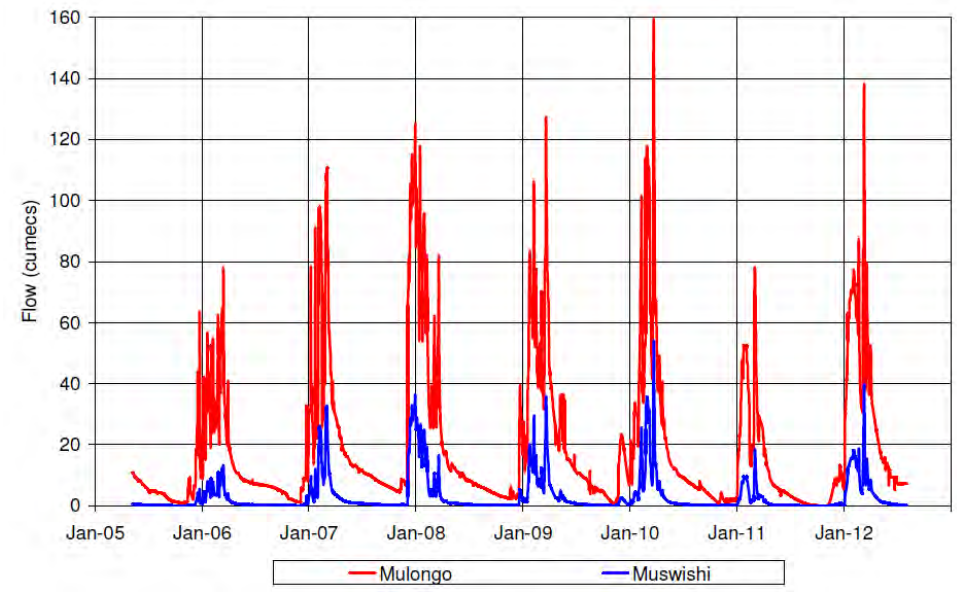
Table 4.2 shows the maximum, minimum and average flows for the obtained flow series using three different approaches. The averages derived that used the two methods based on available discharge data are below the area-ratio value and therefore are likely to provide conservative estimates of the contribution from Muswishi (Mott McDonald, 2013). *Figure 4.6* shows the derived flows for Mulongo and Muswishi.

Table 4.2 Summary of Derived Flows for Mulongo and Muswishi

Location	Maximum (m^3/s)	Minimum (m^3/s)	Mean (m^3/s)
Mulongo	158.0	0	19.59
Muswishi (1)	54.0	0	3.22
Muswishi (2)	55.1	0	2.79
Muswishi (3)	30.3	0	3.76
Combined (1)	203.5	0	22.81
Combined (2)	197.3	0	22.39
Combined (3)	188.3	0	23.35

Source: Mott McDonald (2013)

Figure 4.6 Mulongo and Muswishi Flow Series

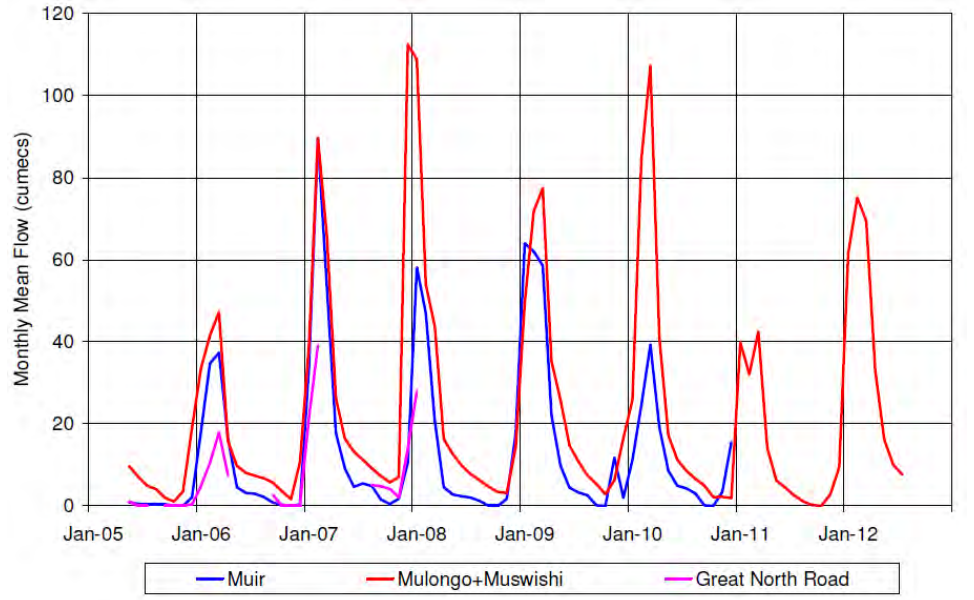


Source: Mott McDonald (2013)

Comparison of Flow Series

Available flow series data have been compared in order to assess whether conclusions could be drawn regarding the likely accuracy of the Muir flow series (a data set of 50 years of flow series requiring verification of accuracy). The comparison involved the combined Mulongo-Muswishi flow, the Muir series and data from the Great North Road gauging station. *Figure 4.7* shows the relationship between the different data series on a monthly time step. It has been found that the derived Mulongo-Muswishi flows are generally significantly higher than the Muir series. The data from the Great North Road gauging station is upstream of Mulongo and intermittent, with a catchment area of less than half that of Mulongo. Overall the Muir data shows extended very low or zero dry season flows which are much lower than those calculated for Mulongo-Muswishi (Mott McDonald, 2013).

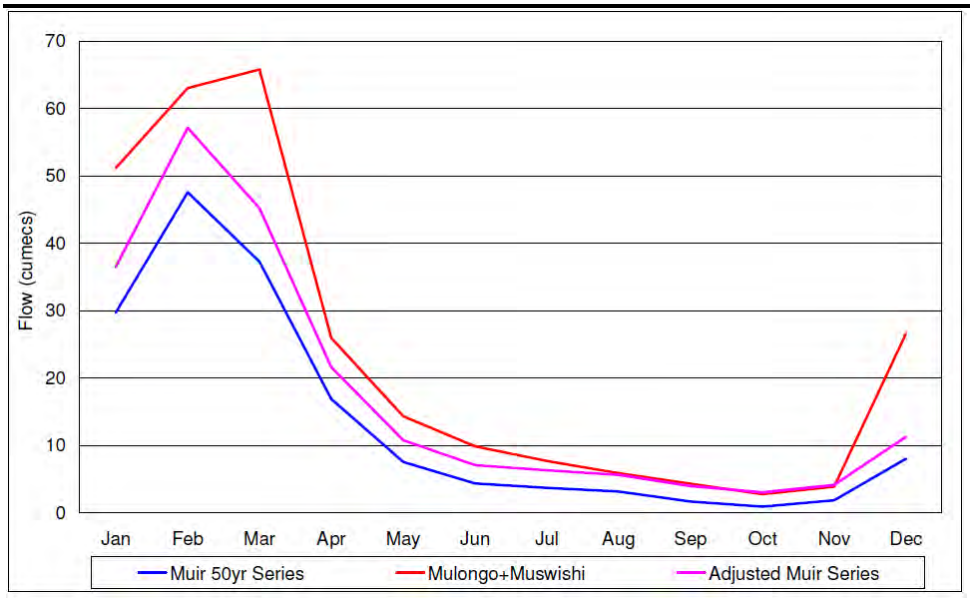
Figure 4.7 ***Comparison of Mulongo-Muswishi, Muir and Great North Road Gauging Station Flows***



Source: Mott McDonald (2013)

The average monthly flows for the three compared series are shown in *Figure 4.8*, and the average flow values are summarized in *Table 4.3*.

Figure 4.8 ***Average Monthly Flows***



Source: Mott McDonald (2013)

Table 4.3 Mean Monthly and Annual Flows (m^3/s)

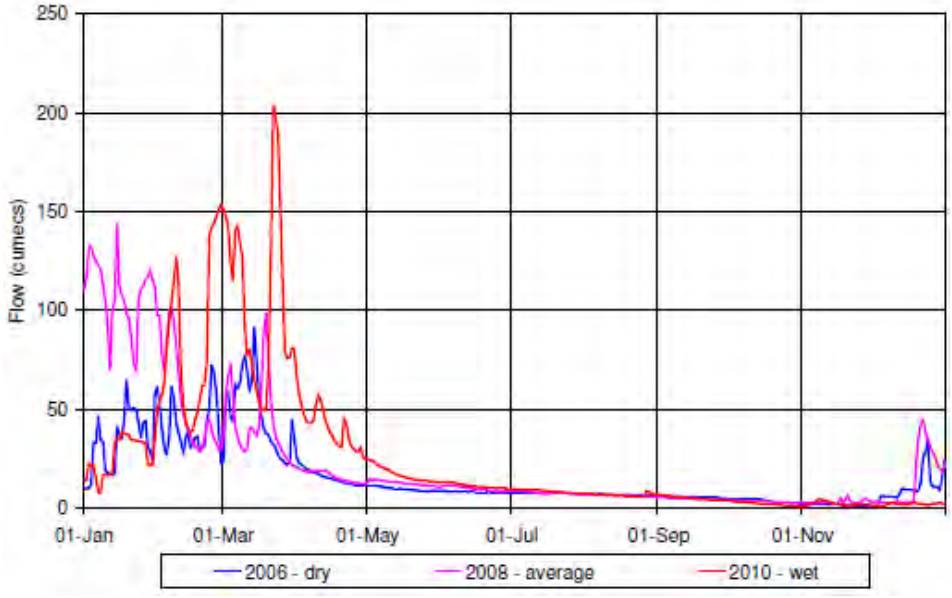
Time Period	Muir Series	Mulongo-Muswishi	Adjusted Muir Series
January	29.68	51.14	36.43
February	47.54	63.02	57.15
March	37.23	65.79	45.19
April	16.89	25.96	21.59
May	7.54	14.28	10.75
June	4.34	9.85	7.04
July	3.69	7.67	6.28
August	3.11	5.87	5.61
September	1.67	4.30	3.94
October	0.89	2.72	3.04
November	1.83	3.88	4.12
December	8.00	26.56	11.27
Year	13.36	23.26	17.48

Source: Mott McDonald (2013)

Daily Flows

Three years of data were selected from the Mulongo-Muswishi series representing dry, average and wet conditions (based on the average flow over the year). The data shows that the dry season flows are fairly consistent between the years. However, there is substantial variation in the patterns and scale of wet season flows (Mott McDonald, 2013). *Figure 4.9* shows the hydrographs for the sampled daily flow patterns.

Figure 4.9 Sample of Daily Flow Patterns (Mulongo-Muswishi)



Source: Mott McDonald (2013)

Conclusion

The study undertaken to date by Mott MacDonald indicates that the Muir data series underestimated the inflows to the Mulungushi Dam. The Mulongo-Muswishi flows represent approximately 90 percent of the overall Mulungushi Dam catchment. The analysis has estimated that the Mulungushi Dam has an average inflow of approximately 17.5m^3/s (calculated over the period 1961 to 2010). This calculation is about 30 percent higher than the Muir calculation (Mott McDonald, 2013).

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Flora and Fauna

During a wet season field visit in February 2013, all the habitats of natural vegetation remaining in the vicinity of the existing Mulungushi Hydropower Station and associated infrastructure (canal, diversion dam, Mulungushi Dam wall, etc.) were investigated. The proposed route of the new access road to the new Mulungushi Powerhouse site was also investigated.

Four major natural vegetation communities were identified and are linked to landform types, in additional to transformed land and degraded secondary woodland. These are:

1. Miombo Woodland on Plateaus and Upper Slopes;
2. Miombo Woodland on Steep Hillslopes;
3. Miombo Woodland on Rocky Ridges; and
4. Riparian Forest and Thicket.

While the species list is not yet complete, it currently lists over 200 vascular plant species. The following species of conservation concern have been identified, but it must be stressed that species identifications are not yet complete:

1. *Khaya anthotheca* – assessed as Vulnerable (IUCN); scattered along the Mulungushi and Katobo Rivers;
2. *Dalbergia melanoxylon* – assessed as Near Threatened (IUCN); in small numbers in Miombo Woodland on Steep Hillslopes; and
3. *Euphorbia cooperi* – has not been assessed by IUCN, but has a national status of Data Deficient; on very steep lower slopes of Katobo River valley, also cliffs at Mulungushi Dam wall.

While many of the species occurring in the Study Area are endemic to the Miombo ecoregion, no range-restricted endemics were confirmed during fieldwork thus far.

Mammals were surveyed through active searching and photographs taken by Bushnell TrailCam cameras placed at various localities through the Study Area. The only mammals confirmed by the cameras were Blue Monkey (*Cercopithecus mitis*) and a squirrel species, the latter being photographed too far from the camera for identification to be confirmed. Four other mammal species were confirmed through visual and audio evidence, although large mammals appear to be absent.

Birds were surveyed through Timed Species-Counts and transects. A total of 140 species were recorded. None of these are classified as threatened, but at least 15 species are endemic or near-endemic to the Zambezian biome. The following species can be considered range-restricted endemics to the Miombo woodlands and riparian forests of this biome:

- Black-backed Barbet (*Lybius minor*)
- Black-eared Seed-eater (*Serinus menellii*)
- Böhm's Flycatcher (*Muscicapa boehmii*)
- Miombo Double-collared Sunbird (*Cinnyris manoensis*)
- Miombo Pied Barbet (*Tricholaema frontata*)
- Miombo Tit (*Parus griseiventris*)
- Pale-billed Hornbill (*Tockus pallidirostris*)
- Red-capped Crombec (*Sylvietta ruficapilla*)
- Rufous-bellied Tit (*Parus rufiventris*)

The most significant impact on terrestrial ecosystems associated with this Project is the new access road down the Katobo River valley to the new Mulungushi Powerhouse site. The very steep, relatively unstable slopes are likely to result in significant erosion during the construction phase, which will mean a high level of sediment deposition in the Katobo River. This impact will need to be addressed by the aquatic specialists.

According to LHPC staff, there is currently an exclusion zone around the Project Area, with no villages allowed to be established in this area. While this potentially places a restriction on the ecosystem services being offered by the terrestrial ecosystems, people were still observed utilising the Project Area, although no large-scale wood-felling or charcoal production was evident.

4.2.2 Aquatic Ecology

The high flow (wet season) aquatic assessment for the Mulungushi HPP was completed in February 2013 by Ecotone and Natural Scientific Services CC (NSS). Due to an unforeseen dam release, the flow velocity and the extent of inundation in the Mulungushi River did not allow for sampling in the main river system. Instead the assessment focused on nearby tributaries, based on the rationale that they will yield aquatic communities which are representative of the Mulungushi

River, as they provide refuge from flood conditions. *Figure 4.10* shows the locality of the sample sites.

Figure 4.10 Mulungushi Tributaries Sample Sites

Source: Ecotone and NSS (2013)

Water Quality

In-situ water quality data including pH, temperature, dissolved oxygen, TDS and electrical conductivity were assessed at each site. The results showed water quality to be good at all the selected sites (Ecotone and NSS, 2013).

Species Richness

A total of 21 fish species were sampled in February 2013. Expressing the species richness as a proportion of the expected species is challenging, as little reference data for the area is available. However, it is estimated that approximately 70 percent of the expected fish species were sampled when considering the available habitat and existing information on fish distribution. The order Cyprinidae (Yellowfish, Minnows, Mudfish and Barbs) showed the highest richness, making up nearly half of the sampled species, with the *Barbus* genera being particularly diverse. The Cichlid family (Mouth-brooders, Tilapias and Breams) were a sub-dominant group (Ecotone and NSS, 2013).

The macro-invertebrate communities in the Study Area had a generally good diversity and species richness. A total of 30 families were identified in the tributaries sampled. There was a greater diversity of families present at sites that were not subjected to very recent flooding events due to high rainfall. At each of the sites, the natural community variation was primarily based on habitat availability with a few site specific trends (Ecotone and NSS, 2013).

Abundances, Composition and Trophic Occupation

In general fish assemblages were dominated by benthopelagic (1), rheophilic or semi-rheophilic (2) species. The macro-invertebrate assemblages in general, were dominated by predatory (Odonata and Hemiptera) and also shredder (Trichoptera) feeding groups (Ecotone and NSS, 2013).

Habitat and Flow Preferences

Fish were sampled in all habitat types available. The majority of fish had a preference for rocky or sandy substrate associated with moderately deep to shallow water column and fast flowing conditions. Little or no overhanging vegetation and aquatic macrophytes were available as fish habitat (Ecotone and NSS, 2013).

The macro-invertebrate assemblages in general, were dominated by more hardy families which are more tolerant to habitat disturbances such as constant flooding in the rainy season and also the absence of some habitats, such as vegetation (Ecotone and NSS, 2013).

General Fish Health

The external condition of fish revealed good health with a low prevalence and intensity of trematode cysts on some individuals. Adults and juveniles were sampled for most of the species, indicating that present environmental conditions have not inhibited reproductive success (Ecotone and NSS, 2013).

Conservation Status

Of the fish sampled in the high flow survey:

- three species require taxonomic resolution;
- two species are listed as Data Deficient;
- two species have not been assessed by the IUCN; and
- the remainder of fish are listed as species of Least Concern.

With the exception of the unresolved species, no endemic fish or fish with range limitations have been sampled (Ecotone and NSS, 2013).

(1) Living and feeding on or near the bottom.
(2) Require constantly or partially flowing water as part of their ecological requirements.

4.3 SOCIO-ECONOMIC ENVIRONMENT

The purpose of this section is to describe the socioeconomic environment within which the Project is located. The description provided in this section is based on publically available, high level secondary and primary data. A full and more current account of the Project Site and area will be provided in the ESIA drawing on primary data collected for this Project.

The Mulungushi HPP is located in Zambia and falls within the Central Province (see *Figure 1.1*) (1). It is located approximately 60km to the south east of Kabwe, which is the provincial capital of the Central Province. The Project affected districts are Kapiri Mposhi District (east of the Mulungushi Dam), and Chibombo District (west of the Mulungushi Dam). The Project Area sits within two chiefdom areas, namely, the Chiefdoms of Chimuka (west of the Mulungushi Dam), Mukonchi (east of the Mulungushi Dam), the Chembe Chiefdom is located south of the Mulungushi Dam (50km downstream), and may also be affected by the Project. The Chiefs preside over these areas under customary law, see *Figure 3.2.*

It is important to note that the Government of Zambia is in the process of adjusting provincial and district boundaries to streamline and improve local government. In 2012, the Government enacted a new district in the Central Province called the Chisamba District. This has been formed through the division of Chibombo District into two districts. This change has not been reflected in this report as the boundary data is currently not available electronically; the updated boundary data will be provided as part of the ESIA (2). It is understood that the area of Chibombo District closest to the Project site now falls under Chisamba District.

The majority of the Project-related infrastructure will be constructed on land owned by the LHPC which is approximately 337.71ha. The land previously belonged to the Zambian Consolidated Copper Mines (ZCCM), then state owned (3). In 2007 after it was privatised, the government resettled all people who had encroached on the land where hydropower stations are located across the country. The resettlement process for the existing Mulungushi Hydropower Station was completed in 2007 (4).

4.3.1 *Socio-economic Areas of Influence*

From a socioeconomic perspective the areas of influence include:

Immediate Area of Influence (Study Area) as described in *Chapter 1* comprises of the land owned by the LHPC and all areas where Project infrastructure will be

(1) The other five Districts are Kabwe, Chibombo, Mkushi, Mumbwa and Serenje.
(2) According to government officials at the mapping office in Zambia, new maps will only be available in June/July 2013.
(3) ZCCM was a state owned copper mining company; it has since been privatised and known as ZCCM-IH. It still owns the largest shares in the public-private partnership of 87 percent.
(4) Even though the resettlement process was completed in 2007, some stakeholders who were part of the process still have some issues with the process.

constructed, specifically the new access road and the new Mulungushi Powerhouse.

Direct Area of Influence (Project Area) comprising of the following:

- the length of the D241 road starting from the edge of the LHPC property boundary to the start of Kabwe town (65km);
- the 21 villages (see *Table 4.4* and *Figure 4.11* below) situated along the length of the road and a 500 m corridor on either side of the road; and
- Chembe Chiefdom (1) which is downstream from the Project Site located below the confluence of the Mulungushi and Lunsemfwa Rivers (approximately 50km from the Project Site).

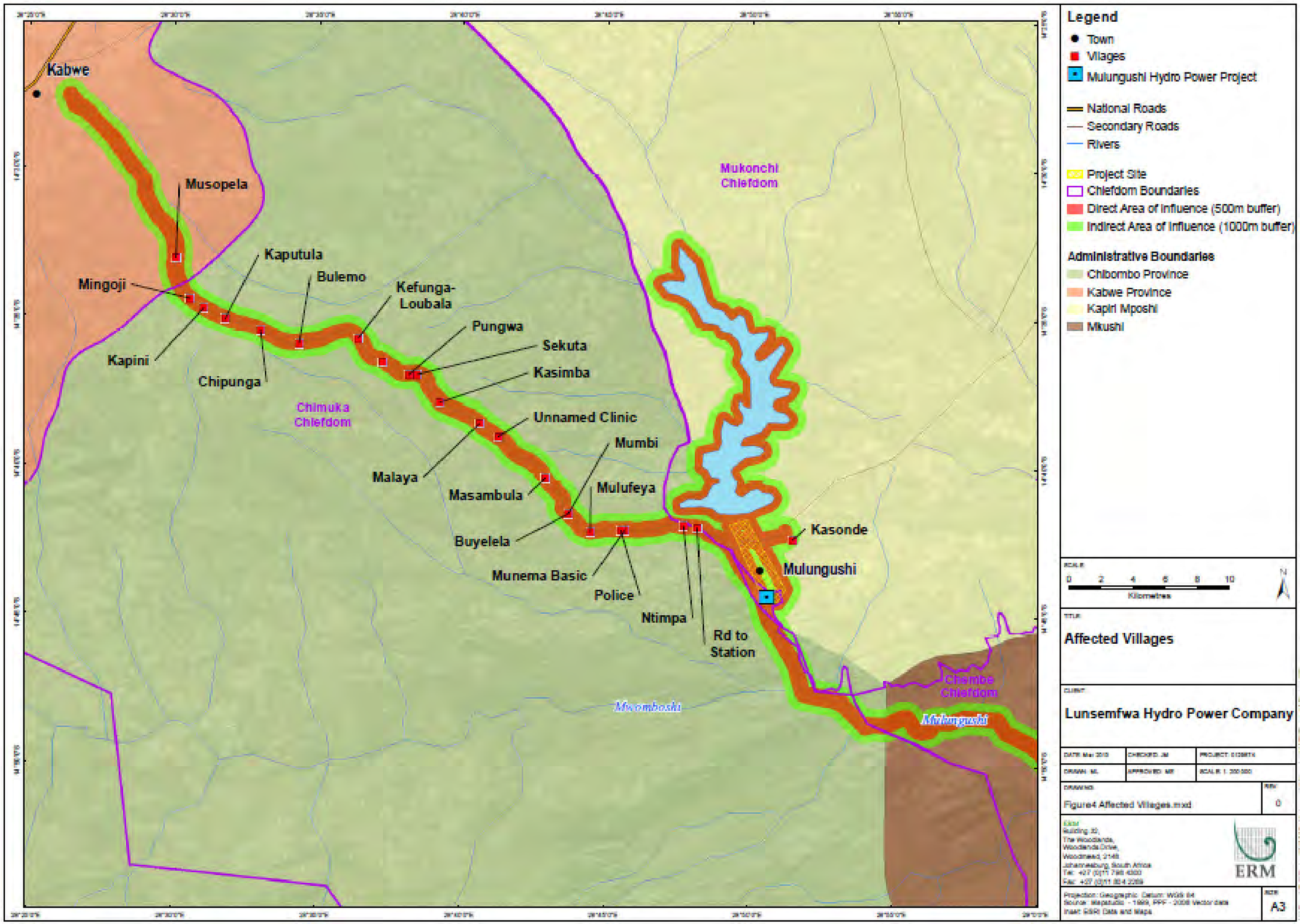
Table 4.4 Project Affected Chiefdoms and Villages

Chiefdoms	Villages
Chimuka	Ntimpa
	Mulufeya
	Mumbi
	Buyelela
	Nomsambila
	Malaya
	Kasimba
	Sekuta
	Pungwa
	Loyumbika
	Kefunga-Loubala
	Bulemo
	Chipunga
	Kaputula
	Kapini
	Mingoji
	Musopela
Mukonchi	Kasonde
Chembe	Chembe
	Liteta
	Chimika

Indirect Area of Influence also follows the road to Kabwe, comprising a one kilometre corridor on either side of the road. This is the only major road in the area and people from as far as five kilometres away make use of it.

(1) Chembe Chiefdom is 50km downstream from the Project Site. The Mkushi River also joins the Lunsemfwa River before it reaches the Chiefdom.

Figure 4.11 Affected Villages

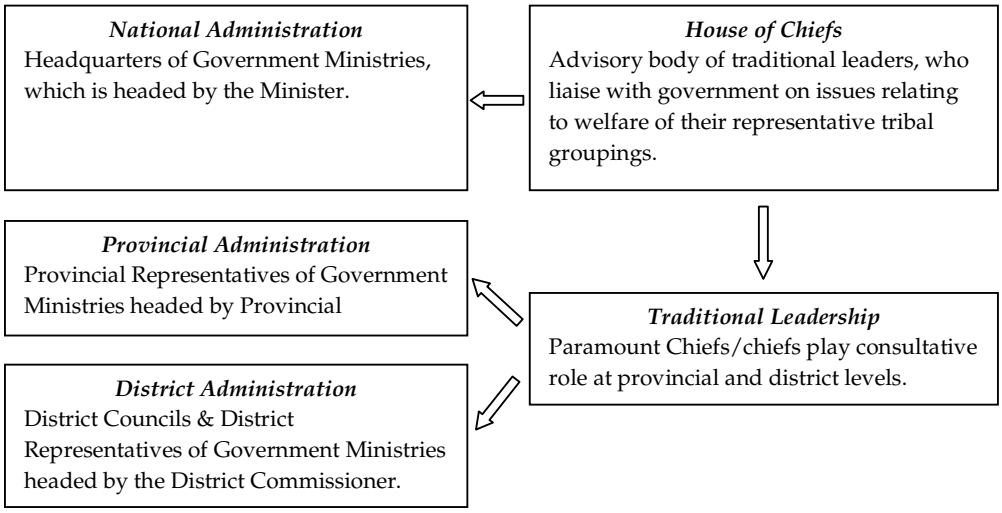


4.3.2 *Administrative Structures and Governance*

There is a dual system of governance in Zambia; the political structures of governance and the traditional leadership structures. The systems of authority are recognised as complementary structures which have differing responsibilities (1). Zambia has a decentralised government; the three key levels of administrative authority in the country lie at the national, provincial and district levels. At national level, governance structures comprise of elected members of parliament. Government functions are performed by the Cabinet of the government of the ruling party through various sector ministries. These ministries are headed by a Minister at national level and have representatives at both the provincial and district levels.

Rural communities of Zambia are led by Chiefs, who are the custodians of local tradition, morals, and the traditional practices of the various national ethnic groups (2). At a national level, Chiefs are represented in the House of Chiefs, an advisory body to the Government with regards to issues relating to the welfare of their respective tribes. *Figure 4.12*shows the relationship between different administrative levels and the traditional authorities.

Figure 4.12 Political and Traditional Governance Structure



Source: Dr Mitulo Silengo

4.3.3 *Land Use*

The total land area in Zambia is estimated to be 752,000km^2. The major land uses in Zambia include forestry (66 percent - 49.9 million hectares) and agriculture

(1) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011
(2) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011

(32 percent) [1]. A significant portion of forested areas comprise of protected areas (*Figure 4.13*) and Game Management Areas [2]. Wetlands comprise ten percent of the total land cover.

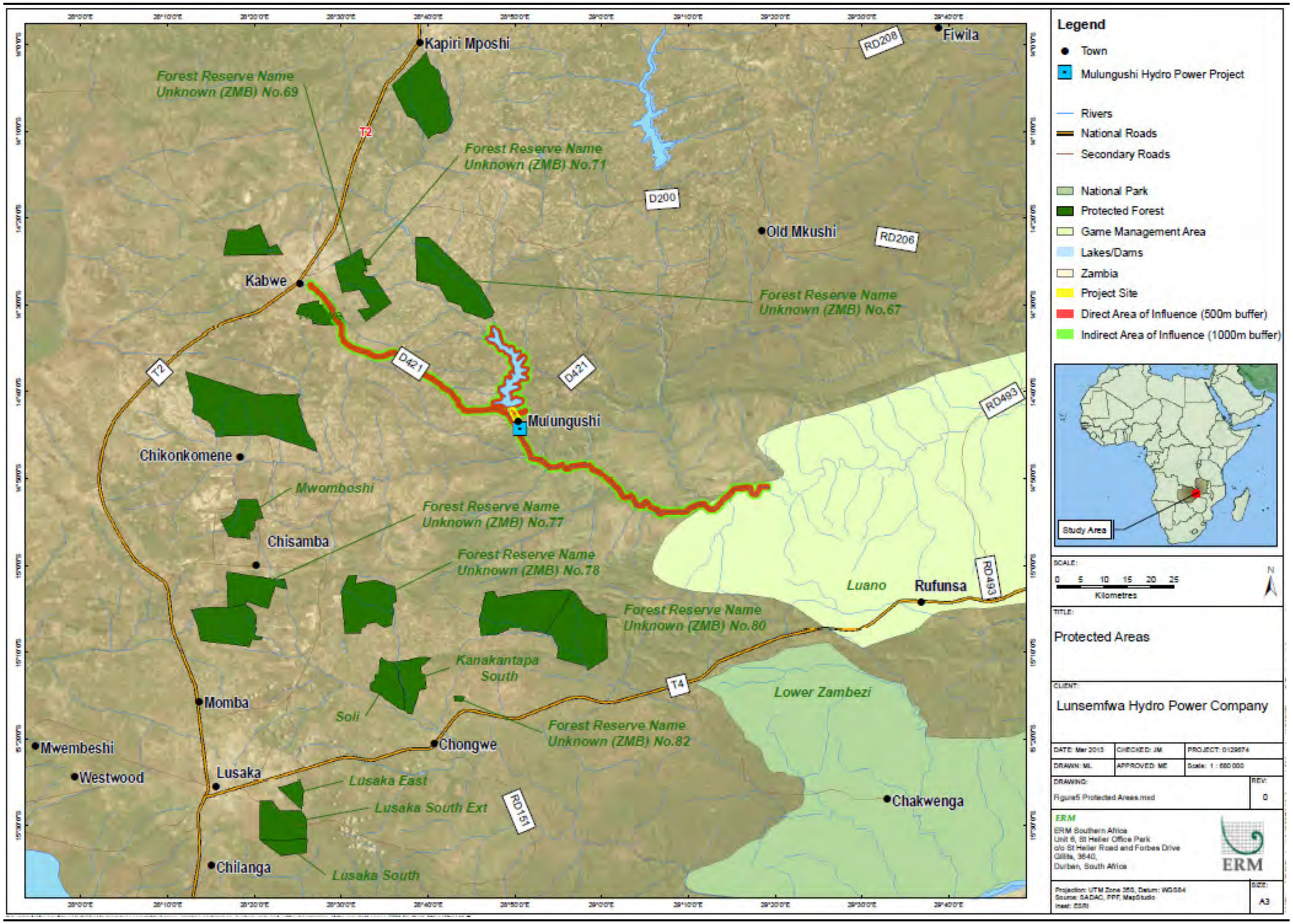
The major land uses in the Central Province include natural forests, National Parks, Game Management Areas and agricultural land. Approximately 52 percent of Provincial land area is forested and 48 percent of the land is described as non-forested land [3]. The non-forested land is commonly used for crops and rural/urban buildings.

State land is used for settlements, commercial activities and social infrastructure, in both Districts. In Kapiri Mposhi District a large proportion of State land is taken by the Tanzania-Zambia Railway's (TAZARA) Dry Port; located in the town of Kapiri Mposhi; which is one of the gazetted non-border entry/exit points for the import and export of goods. Furthermore in Kapiri Mposhi District an estimated 1,335km^2 of land forms part of the Ngabwe Game Management Area (GMA) which is located on the western side of the Mposhi District and is divided into four forest areas. These are Chibwe National Forest, Kapiri-Mposhi Local Forest, Ipumbu Local Forest and Luembe Local Forest [4]. The Luano Game Management Area is also found on the southern-most part of the Kapiri Mposhi and Chibombo Districts, as well as across the Project affected chiefdoms and more. It is one of the largest managed areas in the country at 893,000ha [5].

The Chibombo District covers 13,670km^2. GMAs and forests account for approximately 300,000ha of the Chibombo District, while cultivated land accounts for 150,000ha [6]. In both Districts, customary land is dominated by settlement, subsistence agriculture, harvesting of timber, and non-timber forest products (NTFPs).

(1) ILUA, 2009
(2) Game Management Areas are set aside principally to serve as buffer zones around the National Parks.
(3) ILUA, 2009
(4) DSA, 2010
(5) Integrated Land Use Assessment (ILUA), 2009
(6) Chibombo District Situational Analysis Report (undated).

Figure 4.13 Protected Areas



4.3.4 Energy and Power in Zambia

In Zambia, overall access to electricity is low. According to the Sixth National Development Plan, access to electricity increased from 20 percent in 2005 to 22 percent 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 pace of implementation of the Rural Electrification Programme. In recent years the country has also been experiencing power shortages due to the increase in demand by industry and mines while the supply has remained the same. The main users of electricity are mines (47 percent), households (19 percent), government and services (seven percent), commerce and industry (four percent), and agriculture and forestry (two percent) (1).

Firewood accounts for about 70 percent of the total national energy demand while electricity, petroleum and charcoal account for 14 percent, 12 percent and two percent, respectively, and other sources account for two percent. Hydroelectric power plants represent 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 900MW, 600MW and 108MW of power, respectively. Other small scale hydropower sources are Mulungushi (28.5MW) and Lunsemfwa (18MW) hydropower plants. The country's hydropower resource potential stands at an estimated 6,000MW that could be harnessed to promote economic growth, while the installed capacity is closer to 1,788MW (2).

In the Central Province, only 12 percent of households have access to electricity. A significantly smaller portion of rural households have electricity (four percent) compared to urban households (48 percent) (3).

In the Kapiri Mposhi District, power consumption has increased 150 percent between the years 2007 and 2009 for both residential and industrial/ farming users (4). While in the Chimbo District, the number of people with access to electricity increased from 19 percent to 27 percent between 2006 and 2009. During that same period the number of people using solar power increased from five to seven percent (5). Some of the challenges posed by the lack of or insufficient electricity supply include:

- electricity black-outs;
- lack of critical line materials such as poles and conductors;

(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) Sixth National Development Plan, 2011 - 2015
(4) Kapiri Mposhi Integrated Development Plan, 2012
(5) Chibomba District Situational Analysis (undated)

- lack of transformers to improve quality and security of supply and connectivity;
- illegal connections; and
- defaulters on the payment of bills.

With the exception of the Mulungushi hydropower plant, the remainder of the Project Area does not have access to electricity. People tend to use battery operated lamps and candles for lighting, firewood and charcoal for cooking and heating. Some people use batteries and solar energy for lighting and charging of cellular phones.

4.3.5 Population Demographics

In 2010, the Zambian population was an estimated 13,046,508 (1). The population split between males and females is almost even, at 51.2 percent female, and 48.9 percent males (2). The majority of the population (65 percent) resides in rural areas and 35 percent in urban areas (3).

The population of Central Province was estimated to be 1,267,803; this showed a population increase of approximately 25 percent between 2000 and 2010 (4). Despite the population increase, the average annual population growth rate in the Central Province declined from 2.7 percent to 2.3 percent between 2000 and 2010 (5) . The Central Province still remains the fourth least populated province, with a population density of 13.4 persons per km^2 (6).

At district level, Chibombo District had a population of 293,765 in 2011 which was higher than that of Kapiri-Mposhi District of 240,841 in 2011. Furthermore, the Project affected Districts, have the largest share of the population (Chibombo 23 percent and Kapiri Mposhi 19 percent) within the Central Province(7). *Table 4.5*shows the population distribution and growth of the Central Province and the Project affected Districts.

Table 4.5 Population Characteristics of the Central Province

District	Total(Number) 2000	Average Annual Population Growth Rate (2000-2010)	Total (Number) 2010	Population Share of Province	Population Density
Chibombo	241,612	2.0	293,765	23.2	21.9
Kapiri-Mposhi	194,752	2.1	240,841	19.0	14.0
Central Province	1,012,257	2.3	1,267,803	100.0	13.4

Source: Census of Population and Housing Preliminary Report – 1 (2011)

(1) Census of Population and Housing: Preliminary Report, 2011

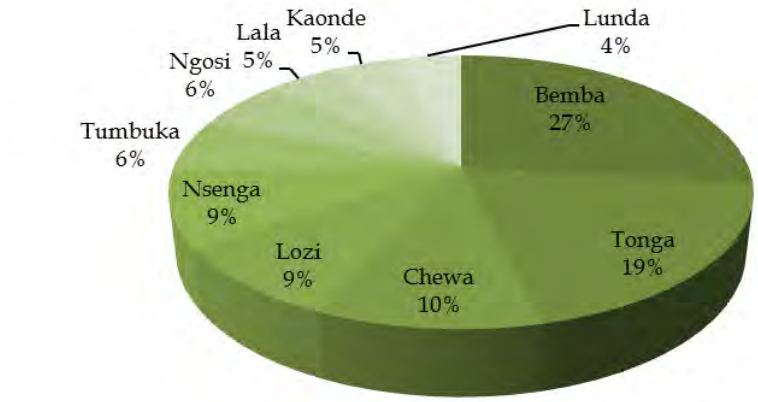
(2) World Bank 2011.
(3) World Bank, 2006.
(4) Census of Population and Housing: Preliminary Report 2011
(5) Census of Population and Housing: Preliminary Report 2011
(6) Census of Population and Housing: Preliminary Report 2011
(7) Census of Population and Housing: Preliminary Report 2011

In the Project Area, the Chief Mukonchi area has a large population (82,939) compared to the Chief Chembe area with a population of 2,108 and Chief Chimuka area whose population is currently unknown. The large population in the Mukonchi Chiefdom may be attributed to the concentration of agricultural activities in the area. Furthermore, the size of the village populations is also unknown; however, the number of households in the villages varies from 60 and 380.

4.3.6 Ethno-linguistic Groups

Zambia has seven broad ethno-linguistic groupings; namely Bemba, Tonga, North-Western, Barotse, Nyanja or Eastern, Mambwe and the Tumbuka (1). All the ethno-linguistic groups in Zambia belong to one of these broad groupings and there are 73 ethno-linguistic groupings (often referred to as tribes) in total. The most dominant ethno-linguistic groups in the country are shown in *Figure 4.14* below. These groups account for two–thirds of the national population (66 percent); the remaining third is formed by minor ethnic groups and foreign nationals.

Figure 4.14 Dominant Ethno-linguistic Groups of Zambia



In the Province, the most widely spoken languages are Bemba, Ila, Kaonde, Lala, Lenje, Nyanja, Sala, Swaka, and Chitonga (2). The dominant ethno-linguistic groups in the districts are Bemba, Lala and Lenje, followed by Swaka, Shona, Ndebele, and Tonga. In the Project Area, the population is mainly comprised of Bemba, Lala, Lenje, and Swaka. The Ndebeles, Zulus (these are migrants from Zimbabwe) and Tongas (migrants from Southern Province) form a minority (3).

There are no people/ tribes classified as indigenous in the country; there are, however, known minority groups, none of whom are defined or self-defined as

(1) Zambian Population Census, 2000
(2) Population and Housing Census, 2000
(3) Personal Communication with villagers in the Project Area, February 2013

indigenous peoples [1]. Minority groups will be further investigated during the impact assessment phase. It is likely that there are minority groups in the wider area, but not 'self-defined' groups who live according to traditional lifestyles.

4.3.7 Economy and Livelihood Activities

This section provides an overview of the economic and livelihoods activities undertaken in the country, province, districts and Project Area.

National Overview

In 2010, the Zambian economy was dominated by three sectors: retail and commercial services, industry (including mining) and agriculture. Retail and commercial services accounted for 46 percent of the Gross Domestic Product (GDP), with the industrial sector accounting for 34 percent and the agricultural sector for 20 percent [2]. Mining is an important subsector within the industrial sector and accounted for 9.1 percent of GDP between 2006 and 2009. During the same period, the mining sector's contribution to foreign exchange earnings amounted to 70.3 percent, and accounted for 8.5 percent of country's formal employment [3] .

The Zambian Government has recognised that there is a lack of diversity in its economy and has outlined targets in the Zambian Vision 2030 to create more diverse opportunities. The plan involves continued development of the existing strong sectors, such as industry and tourism. In addition, emphasis is placed on modernising the agricultural sector, improving efficiency and productivity of the services sector and growing the mining sector [4].

Agriculture remains a key livelihood activity, particularly in rural areas, where over 80 percent of the population depends on agriculture-related activities for their livelihood [5].

The economy in the Central Province is dominated by both subsistence and commercial agriculture [6], which contributes an estimated 70 percent to the Provincial economy. Other economic sectors that form part of the provincial economy include fisheries, tourism, forestry, mining, civil service, and trade and industry [7]. In the 1990s, the mining and industrial sectors formed an important part of the provincial economy; however, with the privatisation of the ZCCM, Zambia Railways and Kabwe Industrial factories, these sectors have declined [8].

(1) United Nation's World Directory of Minorities and Indigenous Peoples Report, 2007
(2) Sixth National Development Plan, 2011 - 2015
(3) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011
(4) Zambia Vision 2030
(5) Six National Development Plan, 2011 - 2015
(6) The agricultural sector is also the largest employer in the Central Province, providing employment to approximately 80 percent of the population.
(7) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011
(8) Baseline Socioeconomic Report for the Proposed Muchinga Hydro Power Station, Dr Mitulo Silengo, 2011

District Level Overview

The primary economic activity undertaken in the Project Districts is **agriculture**; this includes both commercial and subsistence farming. The main commercial crops include maize, tobacco, groundnuts, cotton, sunflower, roses (specifically in Chibombo) and soya beans, while the main subsistence crops are maize (a staple food), sorghum, groundnuts, millet, sweet potatoes and cotton. Livestock reared in both Districts for commercial and subsistence purposes include cattle, sheep, goats (dwarf), pigs, poultry, donkeys and horses. Livestock keeping is affected by stock theft, poor access to veterinary services and lack or inadequate infrastructure (lack of abattoirs, dip tanks, no leather processing plants and feed processing plants) (1).

Fishing is also considered to be an important activity in both of the Districts, with the Lukanga swamp being the main source of fish in both Districts. The Lukanga swamp is owned by Zambian Commercial Fisheries (agency of the state). Much of the fish that are caught are transported to Lusaka and Copperbelt Provinces to be sold (2).

There is some **mining** activity in the Kapiri Mposhi District, including a manganese mine which produces 650,000 metric tonnes of manganese ore annually (3). Other small-scale mining activities involve sand quarrying for building construction. There are no mining activities in the Chibombo District.

Other sectors of employment in the Districts include Government, processing and trade. Other economic activities undertaken in the Districts include trade, charcoal production, finance and tourism. The industrial sector is poorly developed in the Districts.

Project Area Overview

The local economy follows the trends of the Project Districts with **subsistence farming** forming the backbone of the livelihoods activities. The population in the Project Area primarily engaged in subsistence crop production and livestock rearing. Major crops grown are maize, sorghum, beans, sunflower, soya beans, groundnuts, millet and cotton while minor crops grown include cowpeas, sweet potatoes and vegetables (such as tomatoes, cabbages and onions). Maize, cotton and sunflower are grown as commercial cash crops. Livestock reared include cattle, goats, pigs and chickens.

Farming methods utilised include a combination of traditional and modern farming methods, such as cattle drawn ploughs, fertiliser and genetically modified seeds bought in town. Fertiliser is subsidised by government; farmers pay 25 percent of the actual cost. Fertiliser, seeds and pesticides for cotton growers is provided by the private companies (Alliance, Cargrill and Donavant).

(1) Kapiri Mposhi Integrated Development Plan, 2012 and Chibombo District Situational Analysis (undated).
(2) Kapiri Mposhi Integrated Development Plan, 2012 and Chibombo District Situational Analysis (undated).
(3) Kapiri Mposhi District Situation Report, undated

Fishing serves as the secondary livelihood activity undertaken by the population. For people living in Chimuka and Mukonchi areas, fishing activities are undertaken at the Mulungushi Dam. Fishing is allowed in the Mulungushi Dam from April to November as the fish breeding season starts from December and ends in March. Even though fishing is not allowed during breeding season people still continue to fish at the Mulungushi Dam throughout the year. This is also the time when people use illegal fishing equipment to catch fish such as mosquito nets, enabling them to catch the small sized fish. In the Chembe area, fishing occurs on the Lunsemfwa River and nearby streams throughout the year. The commonly caught fish species include *msenga, bangola, brime, mpende, pumbu* and bottle fish. The fish caught are either consumed or sold in Kabwe or Lusaka.

Other livelihood activities that take place in the area include trading, and odd jobs such as cutting grass and building houses. *Figure 4.15* shows local livelihood activities in the Study Area.

Figure 4.15 Local Livelihood Activities: Fishing, Trading, and Agriculture

Fish caught at Mulungushi Dam during the off season


Trading on the side of the road (D421)


Maize fields


Pumpkin and sweet potato fields

4.3.8 Employment and Labour Force

The total number of people employed as a percentage of the total labour force is estimated to be 85 percent. Informal sector employment accounted for 60 percent of the labour force, while the formal sector accounts for only 26 percent. Approximately 14 percent of the population are unemployed. In the formal sector, between 2005 and 2008, male employment accounted for 71 percent,

compared to 29 percent for females [1]. In the rural areas over 80 percent of the population are employed in the agricultural sector and the remaining 20 percent in service, industry and mining [2].

Although the Central Province is considered an urban province, the agricultural sector serves as an important source of employment for 80 percent of the population. The civil service is also a major employer in the Central Province, followed by mining, manufacturing and industries as well as tourism [3]. All these sectors are still in their infancy and offer very few employment opportunities.

As with the trend at national and provincial levels, the agricultural sector is a primary source of employment at the district level; followed by government services, as well as trading, industry, and commercial services [4]. Due to the limited data at district level, it is difficult to ascertain the contribution of the different economic sectors to employment.

In the Project Area there are limited employment opportunities and the majority of the population is engaged in the agricultural sector, especially crop production. The LHPC and government services are the main employers. Many of the people who live in the area used to work for ZCCM but were left unemployed when the company became privatised and people were retrenched. Many young people of economically active age are unemployed and engage in agricultural activities with their families [5].

4.3.9 Social Infrastructure and Utilities

This section provides an overview of the social infrastructure and utilities. These include education, health, roads, water supply and sanitation as well as housing.

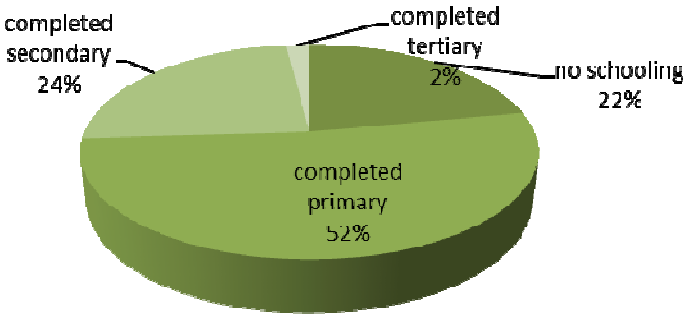
Education

The Zambian education system is a dual schooling system, consisting of basic and secondary school. Basic education comprises nine years of schooling while secondary school comprises six and half years of schooling [6]. In February 2013, government announced that it will recruit 8,000 new school teachers in order to improve the education system and meet its Millennium Development Goals (MDGs) for education [7]. *Figure 4.16* shows the levels of education in the country.

(1) SNDP, 2010
(2) Ministry of Energy and Water Development the Study for Power System Development Master Plan in Zambia Final Report (Summary), 2010
(3) Ministry of Energy and Water Development the Study for Power System Development Master Plan in Zambia Final Report (Summary), 2010
(4) Kapiri Mposhi Integrated Development Plan, 2012 and Chibombo District Situational Analysis (undated).

(5) Personal Communication, February 2013
(6) SNDP, 2011-2015
(7) Heard on Zambian Radio during site visit, February 2013

Figure 4.16 Education Levels in Zambia



Source: SNDP, 2011-2015

The quality of government run schools is dependent on their location (rural or urban). The majority of the urban schools tend to be relatively well resourced with equipment, materials and teachers. Rural schools are generally under resourced and are largely community schools (run by voluntary and untrained teachers) and receive minimal support from the state.

The majority of the schools in the Central Province are state funded, although there are some private schools run by faith-based organisations, private institutions and individuals. As with schools across the country, the quality of government run schools are dependent on their location (rural or urban school). There is a 14 percent dropout rate within the Central Province (1).

Between the Project affected Districts there are 243 schools (basic and secondary schools) (2). Of these only four of the schools are secondary level schools, which explains the high number of pupils not progressing beyond primary school (3). At a community level the Parent Teachers Association (PTA) work hand in hand with respective schools administrators. Despite the high number of schools, the pupil-teacher ratio is still high for primary schools.

In the Project Area there are two schools that are commonly attended by the children, namely Agro and Mulungushi primary and secondary schools. Some of the challenges facing the schools in the area are the shortage of secondary schools, lack of teachers' accommodation, inadequate toilet facilities, and a lack of public transport. In Chembe area there are no high schools in the area and most pupils have to relocate to Rufunsa or Chongwe Districts to attend high school. The lack of public transportation and shortage of secondary schools have attributed to fewer pupils completing schooling in the area (4).

(1) UNDP, 2010
(2) Kapiri Mposhi and Chibombo District Situation Analysis Reports, undated
(3)Kapiri Mposhi Integrated Development Plan, 2012 and Chibombo District Situational Analysis (undated)
(4) Personal Communication, February 2013

Health

Health care services in Zambia are comprised of a three- tier structure, which includes Rural/Urban Health Centres, District Hospitals, and General Hospitals. The provision of health facilities and services remains very poor within the country, with high doctor: patient ratios (one doctor per 10,000 people) and low expenditure on health (4.8 percent of GDP) (1).

The fertility rate in Zambia is high at 5.58 children born per woman (2). There is evidence of an increased mortality rate in the country, which is attributed to the poor health care system, characterised by a shortage of health care professionals, and extremely high rates of malaria, tuberculosis (TB) and HIV/AIDS.

Malaria remains a leading cause of mortality and morbidity in Zambia. It is endemic throughout the country and continues to be a major public health problem, especially among pregnant women and children below the age of five years. Tuberculosis is a leading cause of morbidity and mortality in people living with HIV/AIDS (3).

Like other sub-Saharan countries, HIV/AIDS continues to be a challenge in Zambia. There has, however, been a decline in the HIV/AIDS prevalence rate from 16.9 percent to 14.3 percent between 2006 and 2010. Females have a 16.1 percent probability of being HIV positive and males a 12 percent probability. Urban areas have a higher HIV/AIDS prevalence rate (20 percent) as compared to rural areas (10 percent) (4). An estimated 10 percent of HIV transmission is from mother-to-child. There has been a rapid scale-up of HIV care and treatment in Zambia, enabling many patients to resume active and productive lives. This has resulted in a reduction of HIV-related illnesses that requires in-patient care. An estimated 68 percent of adults and children with advanced HIV were receiving antiretroviral treatment (ART) in December 2009 (5).

There are five District hospitals in the Central Province, one located in each District Council i.e. Chibombo, Kapiri Mposhi, Mkushi, Mumbwa, and Serenje. All referral cases within the Province are referred to the Kabwe General Hospital (approximately 50km from the Project Site).

Kapiri Mposhi District has one district hospital, 17 rural health centres, five urban health centres and two rural health posts. The Chibombo District also has one district hospital, 24 rural health centres and two health posts. Common illnesses affecting the population in both Districts are malaria, Tuberculosis, Sexually Transmitted Infections (STIs), and HIV/AIDS.

There are no hospitals in the Project Area; the population is serviced by health clinics namely Mulungushi Community Health Clinic, Agro CHC, and the

(1) CIA World Fact Book
(2) CIA World Fact Book
(3) National AIDS Council, 2010
(4) It is possible that these statistics are not accurate. These could be skewed by the availability and use of testing facilities.
(5) Ministry of Health/National Aids Council, 2010

Chembe Rural Health Centre (RHC). There is also another unnamed clinic in Chief Chimuka area which was built during the electoral campaign last year (2012); but it is not operational. The majority of the population prefer to go to the Mulungushi CHC as it has adequate personnel, but they all complain that the clinic building is very small and does not allow for privacy. The clinic in Agro has one nurse and there is usually a shortage of medicines, mostly people are given paracetamol for all ailments. Everyone in Chief Chembe area receives medical assistance at the Chembe RHC. Some of the common illnesses treated by the clinics are respiratory infections (cough), malaria, joint pain (mostly reported by the elderly), headaches and diarrhoea.

Roads

The major urban centres in Zambia are connected by road and rail transport. The main trunk roads include the Great North Road, which runs from Lusaka through the Central, Northern and Muchinga Provinces, up to the Tanzania 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 Lusaka-Chirundu border post road. Road passenger transport is operated by private companies.

The province is connected to the rest of the country by the Great North Road which runs from Lusaka through Chibombo, Kabwe, Kapiri Mposhi, Mkushi, Serenje and onward to the Nakonde-Tunduma border. In general, the road infrastructure is poorly maintained and requires rehabilitation. This contributes to slow socio-economic development due to the lack of access to rural areas.

The Great North Road connects both Project affected Districts to other parts of the country, as well as other towns in the Central Province. This is the only paved and adequately maintained road in the Project affected Districts. All access and secondary roads are gravel and are poorly maintained.

Public transportation commonly used in the towns and cities is facilitated by privately owned bus and minibus services, whereas in the rural areas, bicycles are an important mode of transport. People from peri-urban and rural areas, generally, walk to their destinations.

The D421 district road from Kabwe is the main road used by the people in the Project Area and by the LHPC. The road is narrow and gravel and passes through some seasonal streams. It is also severely potholed due to the lack of a drainage system, as well as use by the manganese ore trucks rendering them impassable during the rainy season, see *Figure 4.17*. There is a lack of public transport and people often pay for transport to/ from Kabwe on trucks.

Figure 4.17 Typical Road in the Project Area

4.3.10 Water Supply and Sanitation

In Zambia, more than one third of the population does not have access to potable water and more than half lack access to proper sanitation facilities (1). Water and sanitation facilities in basic schools are generally poor (25 percent) (2). Poor access to clean and safe water increases the level of diseases such as diarrhoea and cholera, among others. In the urban centres water supply and sanitation is reticulated; however, the infrastructure in many of the towns is old and outdated. This has led to the systems being overstretched and not fully able to meet the demands of population growth.

In many rural communities, water is sourced mainly from boreholes and dug wells, hence, the majority of the rural communities do not have access to adequate potable water. In some instances they have to walk long distances to fetch water from streams. In the urban centres people have access to flush toilets, whereas people in peri-urban and rural areas rely on pit latrines.

A similar trend can be observed on the provincial level, where the water supply and sanitation services are inadequate.

Water in the Project affected Districts is mainly sourced from communal water pumps (boreholes) and from the local streams (3). Only the main towns have piped water for the general public. In both Project affected Districts, hand pumps are a common way to access water. The local population also dig shallow wells near running rivers which provide them with water.

Water is a scarce resource in the Project Area, specifically in Chiefs Mukonchi and Chimuka's areas. People access water from the hand pumps which often dry out during the dry season. During this time water is mainly sourced from the Mulungushi Dam. The hand pumps were installed last year during the electoral campaigns, but the piping installed is too short and cannot reach underground

(1) World Bank, 2011
(2) World Bank, 2011
(3) Kapiri Mposhi and Chibombo District Situation Reports, undated

water during the dry season. Some people dig shallow wells in the rainy season in order to collect water for the dry season as they are too far from the Mulungushi Dam . The Chief Chembe area has plenty of water, with the Lunsemfwa River as the main source. There are also plenty of streams and tributaries which people use as sources of drinking water.

Figure 4.18 A Typical Hand Pump in the Project Area

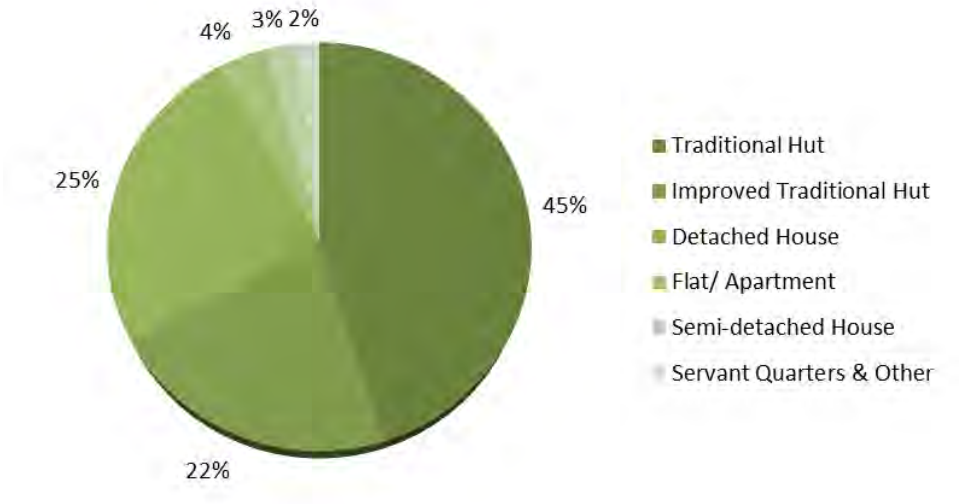
Sanitation facilities in the Project Area comprise of pit latrines. Each headman/woman has to ensure that the villagers under them have pit latrines and are not using the surrounding bush. Those found in contravention of this rule are fined by the headman/woman. *Figure 4.19* below shows a typical latrine found in the area.

Figure 4.19 Typical Pit Latrine

4.3.11 Housing

The most common type of housing in Zambia (particularly in rural areas) is traditional housing constructed with mud-brick walls, while conventional houses are more common in urban areas. Within the Central Province, traditional housing accounts for almost half of the housing stock, followed by improved traditional huts and detached houses, as shown in *Figure 4.20.*

Figure 4.20 Types of Housing in the Central Province



Source: Living Conditions Monitoring Survey Report 2006 & 2010, CSO

The housing stock in the Project Area follows the trend of the national and provincial levels, with most of the houses being traditional huts and there are a limited number of improved traditional huts in the Project Area (see *Figure 4.21*). The houses belonging to LHPC are predominantly brick houses with corrugated iron roofing.

Figure 4.21 Typical Housing in the Project Area

Traditional Hut | Improved Traditional Hut

4.4 HERITAGE RESOURCES

The word *Mulungushi* is of high cultural and heritage value due to its association with Zambian independence and national identity. During the 1960s, pro-independence members of the Zambian African National Congress convened a secret conference at a rocky location along the Mulungushi River, 10km from Kabwe (Mwakikagile, 2010). The conference, which became known as the Mulungushi Rock of Authority, was attended by around 2000 people and resulted in the formation of the United National Independence Party (UNIP) who discussed independence from the colonial authority. The UNIP, led by Kenneth Kaunda, became the major party at independence, and thereafter reiterated the significance of the Mulungushi Rock of Authority conference in many party conferences and policy speeches. The popularity of the name *Mulungushi* resulted in its widespread use, including among others, the Mulungushi Declaration, the Mulungushi Village suburb in Lusaka, Mulungushi Hall and the Mulungushi College in Kabwe.

The cultural and heritage value in the Project Area is primarily related to the Mulungushi Dam and associated Mulungushi hydropower plant which were opened by the then Prince of Wales (the future Edward VIII) in 1925. The Mulungushi hydropower plant, which was constructed to provide electricity to the Broken Hill mine in Kabwe (then known as Broken Hill), will remain operational for the next few years and then be decommissioned. Thereafter, it may be considered to allow visitors to view the almost century-old infrastructure, gaining access via the new access road (*Figure 4.22* and *Figure 4.23*). Other sites of cultural and heritage value in the Study Area include the Mulungushi Bridge (*Figure 4.24*), which was also constructed in the 1920s, as well as an overgrown grave site along the Mulungushi Road to Kabwe, where approximately five headstones are visible (*Figure 4.25*).

An opinion on the possible implications for heritage resources in the Project Area will be provided by a Zambian specialist appointed specifically for this task.

Figure 4.22 Existing Mulungushi Powerhouse: External view (from funicular rail)

Figure 4.23 Existing Mulungushi Powerhouse: Internal View

Figure 4.24 Mulungushi Bridge

Figure 4.25 Old and Overgrown Grave Site

5 INSTITUTIONAL FRAMEWORK AND REVIEW OF LEGAL AND OTHER STANDARDS APPLICABLE TO THE PROJECT

5.1 INTRODUCTION

This chapter sets out the relevant legal and policy standards applicable to this Project. Specifically, this chapter summarises the following:

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

5.2 INSTITUTIONAL FRAMEWORK

5.2.1 *Ministry of Tourism, Environment and Natural Resources*

The Ministry of Tourism, Environment and Natural Resources (MTENR) is responsible for providing guidance on tourism, environment and natural resources issues in Zambia. MTENR's main focus is to ensure the provision of an appropriate legislative and policy framework that guides the management and development of these three sectors. The following statutory bodies fall under this Ministry:

- Zambia Environmental Management Agency (ZEMA);
- Zambia Wildlife Authority (ZAWA);
- National Heritage Conservation Commission (NHCC);
- National Museum Board (NMB);
- Zambia Tourism Board (ZTB); and
- Tourism Training Institute Trust (TTIT).

The function of each of these statutory bodies is discussed below, where relevant to this Project.

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) (EMA) to identify projects, plans and policies for which an EIA is necessary.

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 Article 9(1) of the EMA. 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 environmental management;
- Identify projects, plans and policies that need environmental impact assessments;
- Monitor trends of 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 on the environment;
- Provide for public consultation in environmental decision – making and access to environmental information;

(1) The Environmental Council of Zambia (ECZ) was a statutory body 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).

- 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 EMA.

The 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.

The proposed Mulungushi HPP will be required to submit an EIA to the ZEMA and will require approval from the ZEMA to undertake the proposed Project.

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 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.

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 Museums 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.

5.2.2 Ministry of Energy and Water Development

The Ministry of Energy and Water Development (MEWD) is responsible for the management of energy and water resources in Zambia. The Ministry comprises two Departments, namely; the Department of Energy (DOE) and the Department of Water Affairs (DWA).

The functions of the Department of Energy 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 bye-laws.

The functions of the DWA include the following:

- To oversee and control activities of water resource development and management in order to prevent the indiscriminate tapping 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.

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

- The Energy Regulation Board (ERB);
- The Zambia Electricity Supply Corporation (ZESCO);
- The Water Development Board; 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.

The unit price of that electricity generated by the Mulungushi Hydropower Project and sold to the national grid will be regulated by the ERB.

Zambia Electricity Supply Corporation Limited

Zambia Electricity Supply Corporation Limited (ZESCO) is a parastatal, with the main function of producing power in Zambia. ZESCO produces approximately 80 percent 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).

The Water Development Board

The increase in the population, the demand for water for power generation, direct consumption and other uses of water has increased in Zambia. As such, the Water Development Board was developed in response to these often conflicting demands for water. The Water Development Board is essentially an executive wing of government that provides necessary information for the control of abstractions of water resources 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 Board.

Office for Promoting Private Power Investment

The Office for Promoting Private Power Investment (OPPPI) is responsible for promoting private sector investment in the power generation industry. Its function is to provide an independent assessment of projects and to interface with government authorities and the project developer in terms of ensuring government support to projects.

Through project development, OPPPI assists the project developer to address any issues that the project encounters. As such the Mulungushi HPP, as an IPP will need to engage with the OPPPI through all phases of project development.

5.2.3 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, sectoral agencies and authorities that may also need to be consulted as part of the Mulungushi HPP include:

- Ministry of Fisheries and Livestock;
- Ministry of Agriculture;
- Ministry of Mines and Minerals Development;
- Ministry of Health;
- Ministry of Lands;
- Ministry of Education; and
- Ministry of Local Government and Housing.

5.3 ZAMBIAN ENVIRONMENTAL AND SOCIAL LAWS AND REGULATIONS

5.3.1 Environmental Legislation

The Environmental Management Act

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

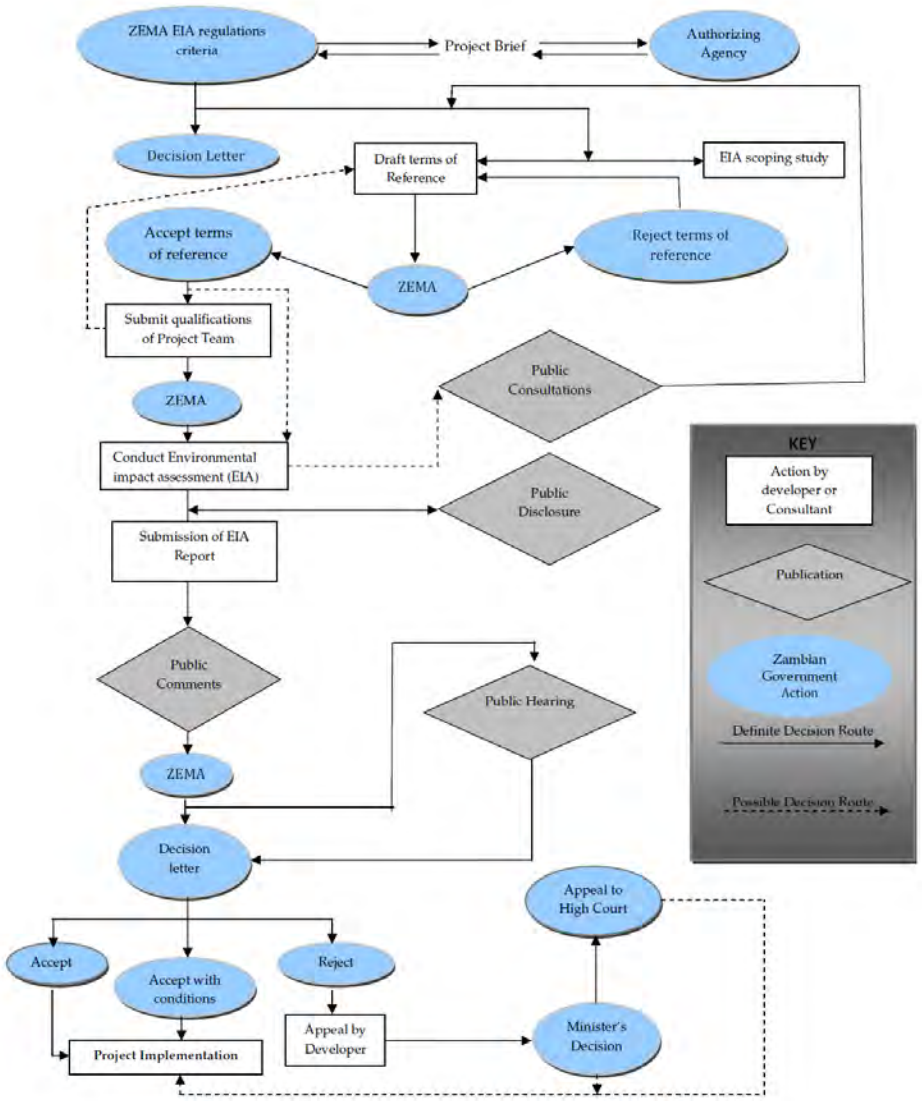
The EMA is divided into twelve parts under the following headings:

Part I	*Preliminary*
Part II	*The Zambia Environmental Management Agency*
Part III	*Integrated Environmental Management*
Part IV	*Environmental Protection and Pollution Control*
• *Division 1 - Pollution Control*	
• *Division 2 - Water*	
• *Division 3 - Air*	
• *Division 4 - Waste Management*	
• *Division 5 - Pesticides and Toxic Substances*	
• *Division 6 - Noise*	
• *Division 7 - Ionising Radiation*	
• *Division 8 - Natural Resources Management*	
Part V	*International Matters*
Part VI	*Environmental Information*
Part VII	*Public Participation*
Part VIII	*The Environmental Fund*
Part IX	*Enforcement Provisions*
Part X	*Reviews and Appeals*
Part XI	*Environmental Offences*
Part XII	*General Provisions*

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 EMA (Act, No 12 of 2011).

The EIA process to be undertaken for this Project is shown in *Figure 5.1* below.

Figure 5.1 Zambian EIA Process



Other Relevant Environmental 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 in EIA decision-making.

Table 5.1 presents a summary of the most relevant national legislation that may be applicable to the Project.

Table 5.1 Summary of Relevant Zambian Environmental and Social Legislation

Issue/ Component	Applicable Legislative Instrument	Description of Legislative Instrument
Natural Resources and Heritage		
Water Resources	• *Water Resources Management Act, No 21 of 2011* • *National Water Policy, 1994*	*Provides for the management of water resources within Zambia.*
	• *Water Pollution Control (Effluent and Waste Water) Regulations,1993*	*Provides for licensing of liquid waste discharge to the environment and also provides for statutory discharge limits for respective parameters.*
	• *Water Supply and Sanitation Act, No 28 of 1997*	*Provides for the supply of clean water and adequate sanitary conditions.*
Wildlife and Natural Resources	• *Zambia Wildlife Act, No. 12 of 1998*	*Provides for the establishment, control and management of National Parks; conservation and protection of wildlife and objects of interest in National Parks; the establishment of Game Management Areas; the licensing of hunting; control of possession of trophies and control of bush fires.*
	• *Forests Act, Cap 199*	*Provides for the establishment and management of National and Local forests, Conservation and protection of forests and trees, and licensing and sale of forest products.*
Waste Management	• *The Waste Management Regulations (SI 71 of 1993)*	*Provides for licensing of solid non-hazardous waste transportation and operating/owning of a non-hazardous waste disposal site.*
Fisheries and Wetlands	• *Fisheries Act, No 22 of 2011*	*Provides for the protection and sustainable utilization of fish in natural water bodies and control of fish farming.*
	• *National Policy on Wetlands Conservation, September 2001*	*Provides for the protection of wetlands.*
Noise & Vibration	• *Part IV of EMA,No.12 of 2011*	*Provides for noise emission standards to be established and requires permits to exceed said emissions.*
	• *Explosives Act (No 10 of 1974) Regulations are in draft stage.*	*Provides for the handling, storage and general management of explosives used for blasting in the mining and construction industry.*
Air	• *Air Pollution Control (Licensing and Emission Standards) Regulations, 1996, made in terms of Part IV of EMA, 2011*	*Provides for licensing of gaseous waste emission to the environment and also provides for statutory discharge limits for respective parameters.*
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.*
Socioeconomic, Archeology and Cultural Heritage		

Issue/ Component	Applicable Legislative Instrument	Description of Legislative Instrument
Health	• *Public Health Act, No 22 of 1995*	*Provides for the prevention of diseases, drainage, latrine and disposal of sewerage and treatment systems.*
Archaeological, Historical and Cultural	• *National Heritage and Conservation Act, 1989*	*Provides for the conservation of ancient cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archeological or scientific interest.*
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* • *Lands and Deeds Registry Act, Cap 174*	*Provides for alienation, transfer, disposition and charge of land.*
	• *Lands Act, Cap 173, 1995*	*The Act guarantees peoples' right to land while enhancing development. The Act recognises 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.*
	• *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.*
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*
	• *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.*

Issue/ Component	Applicable Legislative Instrument	Description of Legislative Instrument
	• *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.*

5.4 ZAMBIAN DEVELOPMENT POLICIES

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

5.4.1 *Zambia Vision 2030*

Vision 2030 expresses Zambia's aspirations in growing the economy, good governance and most importantly developing its people. One key basic principle of Vision 2030 is sustainable development. The vision sets key goals (which are relevant to the Project) 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. The goal is to reduce the heavy reliance on wood fuel, decrease the rate of deforestation and increase the probability for rehabilitation of forest reserves with an overall reduction in the "cost to the Zambian environment".
- There is an upgrade of existing and construction of new infrastructure by developing and implementing private- public partnerships with both local and international industries. By achieving this goal, connectivity is increased and thus an increase in the GDP contribution.
- Zambia's biodiversity is protected in numerous national parks and local forest reserves. By developing, rehabilitating and maintaining these tourist-related infrastructures, Zambia can protect its natural reserves in a sustainable manner that is mutually beneficial to the biodiversity as well as the Zambian economy through tourism.
- 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.

5.4.2 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: (i) infrastructure development; (ii) economic growth and diversification; (iii) rural investment; and (iv) 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 percent, 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.

5.4.3 Central Province Regional Development Plan: 2011 - 2015

The Central 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.
- To increase electricity generation capacity and the construction of proper transmission lines.
- To provide water for productive use (water supply infrastructure eg dams, weirs, hydropower plant schemes).
- To promote sustainable use of natural resources such as water, wood for energy, marine resources etc.
- To promote environmentally friendly technologies for income generation and economic growth.
- To promote reforestation of depleted forests and to maintain the protected reserves.
- To provide rural electrification.

5.5 INTERNATIONAL TREATIES, CONVENTIONS AND PROTOCOLS

Zambia is a signatory 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 5.2 lists the relevant international conventions and protocols to which Zambia is signatory.

Table 5.2 Dates of Ratification of International Conventions

Date of Ratification	Name of Convention
15/11/1994	***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.
04/06/1984	***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.
28/05/1993	***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.
-	***International Union for the Conservation of Nature and Natural Resources (IUCN)*** Zambia recognises the statutes of the IUCN, an international organisation that 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.
08/05/1993	***United Nation Convention to Combat Desertification (UNCCD)*** Zambia 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.
19/09/1996	***United Nations Framework Convention on Climate Change (UNFCCC)*** UNFCCC is an international agreement for the control of climate change.
07/07/2006	***Convention Concerning the Protection of Workers against Occupational Hazards in Working Environments due to Air Pollution and Noise Vibrations*** Zambia recognises the need to protect workers against hazards in working environments.
19/08/1980	***African Convention on the Conservation of Nature and Natural Resources*** Zambia recognises the need to contribute to the conservation of nature and natural resources at a continent level.

5.6 INTERNATIONAL GUIDELINES AND STANDARDS

International guidelines and standards of applicability to this Project, especially with regards International Finance Institutions (IFIs) include the following:

- World Bank Safeguard Policies;
- The IFC performance standards;
- World Commission on Dams (WCDs); and
- The International Hydropower Association (IHA) Sustainability Guidelines and Sustainability Assessment Protocols.

5.6.1 *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 Mulungushi HPP 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 into their development and environmental strategies 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 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. Involvement may include identifying appropriate conservation measures, managing protected areas and other natural habitats, and monitoring and evaluating specific 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.

It 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 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. In this case, a dam safety assessment should be carried out and necessary additional dam safety measures implemented.

Operational Policy 4.37 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.

5.6.2 *The International Finance Corporation*

Performance Standards

The International Finance Corporation (IFC), a division of the World Bank Group that lends to private investors, has recently released a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability (in force from July 2006) (see *Performance Standard* 1: Social and Environmental Assessment and Management System;
Box 5.1). These Standards replace the prior safeguard policies and are used to

- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

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

(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.

borrower's/client's project must comply with the Performance Standards and the applicable Environment Health and Safety (EHS) Guidelines.

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

Box 5.1 IFC Performance Standards

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". (1)

The Performance Standards reinforce the importance of effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them.

Through the Performance Standards, the IFC requires clients to engage with affected communities through disclosure of information, consultation, and informed participation, 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 5.3*, below.

Table 5.3 International Finance Corporation (IFC) Performance Standards

Performance Standards	Objectives
Social and Environmental Assessment and Management System 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).	• *Impact identification and assessment.* To identify and assess social and environmental impacts, both adverse and beneficial, in the project's area of influence • *Mitigation.* To avoid, or where avoidance is not possible, minimise, mitigate, or compensate for adverse impacts on workers,

(1) IFC, 2006.

Performance Standards	Objectives
	affected communities, and the environment • *Stakeholder engagement.* To ensure that affected communities are appropriately engaged on issues that could potentially affect them • *Effective management.* To promote improved social and environment performance of companies through the effective use of management systems
Labour and Working Conditions **Performance Standard 2** recognises that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers.	• To establish, maintain and improve the worker management relationship. • To promote fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labor and employment laws. • To protect the workforce by addressing child labour and forced labor. • To promote safe and healthy working conditions, and to protect and promote the health of workers.
Pollution Prevention and Abatement **Performance Standard 3** recognises that increased industrial activity and urbanisation often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level.	• To avoid or minimise adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities • To promote the reduction of emissions that contribute to climate change
Community Health, Safety and Security **Performance Standard 4** recognises that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development.	• To avoid or minimise risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances • To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimises risks to the community's safety and security
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 or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities • To promote the reduction of emissions that contribute to climate change
Biodiversity Conservation and Sustainable Natural Resource Management **Performance Standard 6** recognises 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 promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities
Indigenous Peoples **Performance Standard 7** recognises that Indigenous Peoples, as social groups with	• To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural

Performance Standards	Objectives
identities that are distinct from dominant groups in national societies, are often among the most marginalised and vulnerable segments of the population.	resource-based livelihoods of Indigenous Peoples • To avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimise, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner • To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project • To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples • To respect and preserve the culture, 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 equitable sharing of benefits from the use of cultural heritage in business activities

5.6.3 IFC Environmental, Health and Safety (EHS) Guidelines

The EHS Guidelines are technical reference documents that 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 host country (Zambia) regulations 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.

There are no industry specific guidelines for Hydropower Projects, although guidelines do exist for electrical power transmission and generation.

General EHS Guidelines also exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors are listed in *Box 5.2.*

Box 5.2 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

5.6.4 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. (1)

(1) World Commission on Dams (2000a)

The WCD framework puts forward seven strategic priorities which are widely acknowledged as a framework for dialogue (see *Table 5.4*). 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 5.4 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 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.

5.6.5 International Hydropower Association (IHA) Sustainability Guidelines

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

- new energy projects;
- new hydro 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.

5.6.6 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. The sustainability of a hydropower project is assessed through the use of assessment tools. These tools are framed by underlying principles of sustainability, as set out in *Box 5.3*, below.

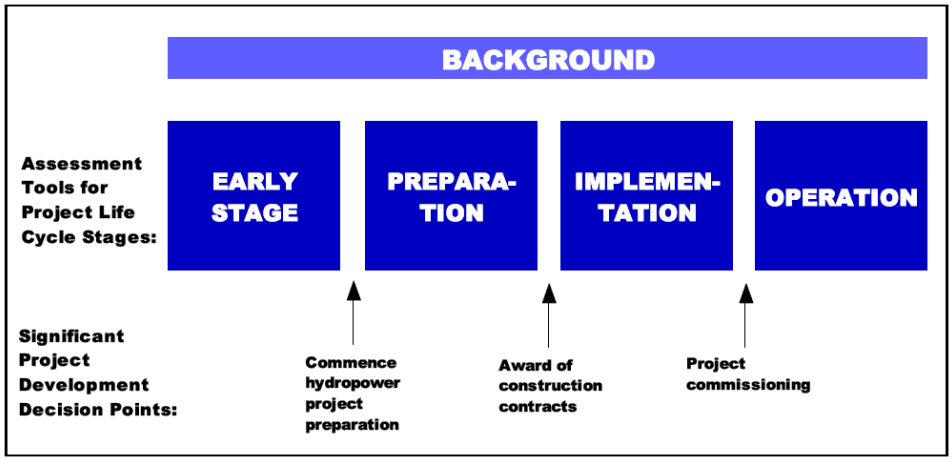
Box 5.3 ***Principles Underlying the IHA Sustainability Assessment Protocol***

The principles underlying the Protocol stipulate that:

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainable development embodies reducing poverty, respecting human rights, changing unsustainable patterns of production and consumption, long-term economic viability, protecting and managing the natural resource base, and responsible environmental management.
- Sustainable development calls for considering synergies and trade-offs amongst economic, social and environmental values. This balance should be achieved and ensured in a transparent and accountable manner, taking advantage of expanding knowledge, multiple perspectives, and innovation.
- Social responsibility, transparency, and accountability are core sustainability principles.
- Hydropower, developed and managed sustainably, can provide national, regional, and local benefits, and has the potential to play an important role in enabling communities to meet sustainable development objectives.

The Protocol comprises of four assessment tools for the different stages of the project life cycle, as shown in *Figure 5.2*.

Figure 5.2 ***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.

Table 5.5, provides a list of topics for each assessment tool. These topics, 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.

Table 5.5 Hydropower Sustainability Assessment Protocol Topics by Section

Early Stage	Preparation	Implementation	Operation
Demonstrated Need	Communications & Consultation	Communications & Consultation	Communications & Consultation
Options Assessment	Governance	Governance	Governance
Policies & Plans	Demonstrated Need & Strategic Fit		
Political Risks	Siting & Design		
Institutional Capacity	Environmental & Social Impact Assessment & Management	Environmental & Social Impact Assessment & Management	Environmental & Social Issues Mgmt
Technical Issues & Risks	Integrated Project Management	Integrated Project Management	Technical Issues & Risks
Social Issues & Risks	Hydrological Resource	Hydrological Resource	Social Issues & Risks

Early Stage	Preparation	Implementation	Operation
Environmental Issues & Risks	Asset	Environmental Issues & Risks	Asset Reliability & Efficiency
Economic & Financial Issues & Risks	Infrastructure Safety	Infrastructure Safety	Infrastructure Safety
Financial Viability	Financial Viability	Financial Viability	Financial Viability
Project Benefits	Project Benefits	Project Benefits	Project Benefits
	Economic Viability		
	Procurement	Procurement	
	Project Affected Communities & Livelihoods	Project Affected Communities & Livelihoods	Project Affected Communities & Livelihoods
	Resettlement	Resettlement	Resettlement
	Indigenous Peoples	Indigenous Peoples	Indigenous Peoples
	Labour & Working Conditions	Labour & Working Conditions	Labour
	Cultural Heritage	Cultural Heritage	Cultural Heritage
	Public Health	Public Health	Public Health
	Biodiversity & Invasive Species	Biodiversity & Invasive Species	Biodiversity & Invasive Species
	Erosion & Sedimentation	Erosion & Sedimentation	Erosion & Sedimentation
	Water Quality	Water Quality	Water Quality
		Waste, Noise & Air Quality	
	Reservoir Planning	Reservoir Preparation & Filling	Reservoir Management
	Downstream Flow Regimes	Downstream Flow Regimes	Downstream Flow Regime

6 SUMMARY OF PUBLIC PARTICIPATION PROCESS

This *Chapter* provides a summary of the public participation process (PPP) to be undertaken as part of the Project as well as outline the preliminary findings of the public participation process to date. Supporting documentary proof is provided within *Annex B* (Consultation Materials) under the headings below:

- *Annex B1*: Background Information Document (BID);
- *Annex B2*: Proposed Consultation Schedule;
- *Annex B3*: Development Presentation (given at community meetings);
- *Annex B4*: Issues and Concerns Log;
- *Annex B5*: Proof of Consultation: Photolog and Attendance Registers from Authority and Community Consultations;
- *Annex B6*: Proof of Advertisements;
- *Annex B7*: Proof of Site Notices; and

The Chapter is divided into three main sections, namely:

1. Pre-Scoping phase consultation
2. Scoping phase consultation; and
3. ESIA phase consultation.

6.1 PRE-SCOPING PHASE CONSULTATION

The pre-scoping phase consultation activities were undertaken as part of the Social Impact Assessment (SIA) study data gathering process. Other purposes of the pre-scoping site visit were to:

- inform the government and traditional authorities as well as communities about the Project;
- gather and record the communities' initial issues and concerns about the Project;
- inform people about the upcoming public participation process for the Project (ie future scoping and ESIA consultations);
- strengthen relationships between stakeholders and the LHPC; and
- understand the best approach and methodology of engaging the communities in the area.

During this stage of the Project, no formal PPP documents were distributed, as such only high level information about the Project was verbally provided to the communities and authorities.

6.1.1 Approach and Method

Stakeholders were given the opportunity to raise their issues and concerns during focus group discussions (FGD) for the SIA. There was no formal or specific methodology set out for stakeholder consultation during this phase.

6.1.2 Identification and Selection of Stakeholders

There were three key stakeholder groups identified as part of pre-scoping, namely i) national, provincial and district government authorities; ii) traditional authorities (including Chiefs and Headmen/women); and iii) local communities/ villagers. Government authorities were selected based on the geographical location of the Project Area. Chiefs, Headmen/women and communities were selected based on the proximity of their villages to the Project Site and other Project affected areas. These included the 18 villages located along the road (D421) from the Project Site to Kabwe town.

Government authorities that were engaged are Kapiri Mposhi and Chomombo District Planners, Provincial Statistician and Provincial Planner (see *Annex B5*). These were high level and one-to-one consults during a visit from the social specialist to request secondary social data. No formal invitation or documents were given to these authorities.

6.1.3 Summary of Issues and Concerns Raised During Consultation

Below is a list that provides a summary of the issues and concerns raised to date. A complete record of the engagement is provided in the Issues Log *Annex B4*.

- Potential secondary development in the area and potential compensation to those affected by the widening of the road;
- Potential employment opportunities, particularly for women;
- Personal, local and national power supply;
- Project awareness amongst community members;
- Need to inform headmen of field-work and meetings;
- Community Based Organisation (CBO) funding from ERM;
- Social and issues related with surrounding communities, including – displacement, project boundaries in relation with chiefdom boundaries, impacts to subsistence crops and employment opportunities;
- Permission to hunt and grow crops in project area; and
- Health related issues, such as increased cases of malaria.

6.2 SCOPING PHASE CONSULTATION

This section provides a draft plan for the scoping phase consultation process. The purpose of the consultation process during this phase will be to:

- inform stakeholders about the ESIA and proposed Project;

- gather comments and concerns regarding the Project; and
- further strengthen relationships with the stakeholders.

6.2.1 Approach and Method

Several consultation methods are likely to be used to engage stakeholders for the purpose of this Project. *Table 6.1* below highlights some of these methods and lists advantages of using them. A detailed description of the approach and method will be provided in the ESIA.

Table 6.1 Consultation Methods to be Used

Consultation Method	Objective of Consultation	Justification for Methodology	Target Audience
Community/ Public Meeting (specifically selected community)	• Share information about the proposed project. • Provide opportunity for stakeholders to raise issues and concerns about the proposed project. • Provide responses to project related questions. • Record stakeholder comments and concerns for consideration in the ESIA.	• Increased ownership by participants • Allows for wider consultation and debate related to selected issues and topics. • Allows issues to be verified, tested and solutions developed.	Villagers and headmen/women
Focus Group Discussion (FGD)	• To provide information about the Project. • To allow community members to raise issues and concerns related to the project. • Allow issues to be verified, tested and solutions developed.	• Increased ownership by participants. • Allows for wider consultation and debate related to selected issues and topics. • Smaller forum encourages participation of all present stakeholders without intimidation or fear (especially people who will not normally speak out in large gatherings). • Allows issues to be verified, tested and solutions developed.	Authorities (National; District and Provincial level)
One-to-One Meetings	• To provide information about the project	• Allows for follow up on issues and unexpected	Interest Groups such as Zambian Game Management Agency

Consultation Method	Objective of Consultation	Justification for Methodology	Target Audience
	activities. • To allow key informants to raise issues and concerns about the project. • To verify some of the information provided by the communities.	information. • Consultation by invitation only, so it is easier to predict and prepare for the types of issues that are likely to be raised. • Allows issues to be verified, tested and solutions developed.	Some National Authorities
Ad hoc Discussions with Community Members	• Opportunity to cross-check information about community concerns and socio-economic baseline information gathered in other forums. • Act on observations made while in the communities.	• To allow people who may not have attended meetings a space to raise issues and concerns or those who were unable to talk in the large community meeting forum.	Community members selected on an ad hoc basis from the Project Area

6.2.2 Identification of and Selection of Stakeholders

An important component of any consultation process is the identification of stakeholders who should be made aware of the ESIA process. Criteria will be developed and used to identify the relevant stakeholders for consultation purposes.

6.2.3 Criteria for the Identification and Selection of Stakeholders

This section will provide a criteria used for the identification and selection of stakeholders for engagement purposes. At present only a high level identification and selection process has been undertaken; and below is a list of stakeholders we believe are relevant to the process.

- **National Level:**
  - Environmental Council of Zambia – Director
  - Ministry of Energy and Water Development – Director of Water
  - Ministry of Energy and Water Development – Director of Energy
  - Energy Regulation Board – Director
  - Mine Safety Department – Director

- **Provincial Level:**
  - Central Province – Provincial Permanent Secretary
  - Ministry of Agriculture – Provincial Officer
  - Ministry of Livestock and Fisheries – Provincial Officer
  - Ministry of Lands – Provincial Land Officer

- **District Authority and Legislator Level:**
  - Chibombo [1] and Kapiri Mposhi Districts – District Commissioners
  - Chibombo and Kapiri Mposhi Districts – Council Secretaries
  - Chibombo and Kapiri Mposhi Districts – Members of Parliament
  - Chibombo and Kapiri Mposhi Districts – District Planners
  - Area Councillors

- **Traditional Authority Level:**
  - Chimuka Chiefdom – His Royal Highness (HRH) Chief Chimuka
  - Mukonchi Chiefdom – HRH Chief Mukonchi
  - Chembe Chiefdom – HRH Chief Chembe

- **Villages Level:**
  - Headmen/women
  - Villages (See list of villages in *Table 6.2* below):

The following villages were identified during the pre-scoping site visit. These villages are located along the D421 road from the Mulungushi Power Station to Kabwe town.

Table 6.2 ***Villages Situated Along the D421 Road from Mulungushi Power Station to Kabwe Town***

Village Name	
1. Kasonde (closest to the station)	10. Pungwa
2. Ntimpa	11. Loyumbika
3. Mulufeya	12. Kefunga-Loubala
4. Mumbi	13. Bulemo
5. Buyelela	14. Chipunga
6. Nomsambila	15. Kaputula
7. Malaya	16. Kapini
8. Kasimba	17. Mingoji
9. Sekuta	18. Musopela (last village before Kabwe)

The initial stakeholder list of District, local headmen/women, and other stakeholders that were met as part of the pre- scoping phase consultation is presented in *Annex B5.*

6.2.4 Notification of Stakeholders

A number of methods will be used to notify national, regional and local stakeholders. These will include but not be limited to the following:

(1) As noted in Chapter 1, the Chibombo District recently split into the Chibombo and Chisamba Districts. The Mulungushi HPP is expected to be situated in the Chisamba District, but this can only be confirmed when updated mapping information is released in June 2013.

Formal Letters of Invitation

Formal letters of invitation will be delivered to stakeholders identified, specifically formal and traditional authorities.

Background Information Document

In addition to the formal letters of invitation, a background information document (BID) will be prepared in English and Bemba which provides a description of the proposed project, an overview of the ESIA process and contact details in order for stakeholders to provide comments on the project. The BID will be distributed during the notification period and the meetings.

Newspaper Advert

An advertisement (in English) notifying stakeholders of the date and location of the public meetings related to the ESIA will be placed in the national newspaper, *The Times of Zambia*.

Site Notices

In addition to newspaper adverts, a number of site notices (in English and/ Bemba) will be placed at locations conspicuous to the public (market places, public notice boards etc.

Project Website

A Project website will be set up at the outset of the ESIA process. The purpose of this website is to keep stakeholders updated on the Project progress; to allow stakeholders to access information on the ESIA process; and to provide the contact details of the ESIA project management team. The BID (English and Bemba) once completed will be accessible on the website.

6.2.5 Meetings Schedule

This section outlines the meetings that are proposed to take place in April 2013 during the Scoping phase consultation.
Table 6.3 outlines the proposed meetings that will take place with authority and other key government officials.

Table 6.3 Authority and Other Key Government Meetings

Stakeholder
National, Provincial and District
Chibombo and Kapiri Mposhi District Commissioner
Provincial Permanent Secretary
National Heritage and Conservation Commission
Ministry of Energy and Water Development, Department of Energy (MEWD)
Environmental Council Of Zambia (ECZ)
Office for Promoting Private Power Investment (OPPPI)
Energy Regulation Board (ERB)

Stakeholder
Ministry of Tourism, Environment and Natural Resources
Ministry of Water and Energy, Director of Water Affairs
Chibombo and Kapiri Mposhi District Education Board Secretary (DEBS)

Minutes will be prepared for each of the above mentioned meetings and a proposed template for the meeting minutes is presented in *Annex B5*.

6.2.6 Proposed Chiefdom and Chiefdom Community Meetings

Table 6.4 outlines the proposed chiefdom and chiefdom community meetings to be held during the scoping phase consultation.

Table 6.4 Chiefdom and Chiefdom Community Meetings

Reference Number	Date	Stakeholder	Venue
		Chief Chimuka	
	June/ July	**Villages:**	
	June/ July	Ntimpa	
	June/ July	Mulufeya	
	June/ July	Mumbi	
	June/ July	Buyelela	
	June/ July	Nomsambila	
	June/ July	Malaya	
	June/ July	Kasimba	
	June/ July	Sekuta	
	June/ July	Pungwa	
	June/ July	Loyumbika	
	June/ July	Kefunga-Loubala	
	June/ July	Bulemo	
	June/ July	Chipunga	
	June/ July	Kaputula	
	June/ July	Kapini	
	June/ July	Mingoji	
	June/ July	Musopela	
		Chief Mukonchi	
	June/ July	**Village:**	
	June/ July	Kasonde	
		Chief Chembe	
	June/ July	**Villages:**	
	June/ July	Chembe	
	June/ July	Liteta	
	June/ July	Chimika	

A stakeholder attendance list and minutes will be taken (a template is presented in *Annex B5)*.

6.2.7 *Summary of Issues and Concerns Raised During Consultation*

All issues and concerns raised by stakeholders during the meetings will be captured in the issues log, which will be updated during course of the ESIA.

6.3 *ESIA PHASE CONSULTATION*

The purpose of the ESIA phase consultation will to:

- inform stakeholders about the findings of the specialists reports;
- gather comments and concerns regarding the potential impacts;
- identify potential mitigation measures that might have been missed; and
- further strengthen relationships with the stakeholders.

6.3.1 *Approach and Method*

Formal stakeholder meetings will be held. The plan will be to engage mainly with government (national, provincial, and district) and traditional authorities (Chiefs and Headmen/headwomen). Should the Project impacts be expected to significantly affect the local communities, then communities will also be engaged.

6.3.2 *Notification of Stakeholders*

Stakeholders will be notified of the meetings by e-mail (government officials), letters and phone calls (specifically Headmen/women). E-mail communication and follow up phone calls will be sent directly by the ERM team, while letter will be distributed by on-site personnel from the LHPC.

The ESIA report will be available on the Project website; hard copies and other electronic copies will be available on request by stakeholders.

6.3.3 *Meetings Schedule*

This section outlines the meetings that are proposed to take place during the ESIA phase consultation. Dates for this phase are to be confirmed.

Table 6.5 Proposed Meetings with Key Government and Traditional Authorities

Stakeholder
National, Provincial and District
Chibombo and Kapiri Mposhi District Commissioner
Provincial Permanent Secretary
National Heritage and Conservation Commission
Ministry of Energy and Water Development, Department of Energy (MEWD)
Environmental Council Of Zambia (ECZ)
Office for Promoting Private Power Investment (OPPPI)
Energy Regulation Board (ERB)
Ministry of Tourism, Environment and Natural Resources

Stakeholder
Ministry of Water and Energy, Director of Water Affairs
Chibombo and Kapiri Mposhi District Education Board Secretary (DEBS)
Chiefs Mukonchi, Chimuka, and Chembe
Headmen/Women from the project affected area(s)

Minutes will be prepared for each of the above mentioned meetings and a proposed template for the meeting minutes is presented in *Annex B6*.

6.3.4 Summary of Issues and Concerns Raised During Consultation

This section will provide a summary of issues and concerns raised by the stakeholders. A full list of issues and concerns will be provided in the Issues Log *Annex B4*.

Mitigation measures proposed by authorities and any other stakeholder will be worked into the relevant section of the ESIA once the Proponent has agreed to adhere to them. These will be included in the Issues Log.

7 DETERMINATION OF THE POTENTIAL IMPACTS OF THE PROPOSED PROJECT

This *Chapter* describes potential socio-economic, physical and biological impacts that are associated with the Project. The issues identified stem from those aspects investigated and presented in *Chapter 4* of this document. Each significant issue identified will be investigated further during the impact assessment phase of this Project.

Furthermore, this *Chapter* will describe the methodology that will be used in the ESIA phase to indicate how environmental and socio-economic impacts, arising from both the construction and operations phase of the Project, will be assessed and mitigated.

7.1 POTENTIAL ENVIRONMENTAL IMPACTS

This section describes the potential impacts to the biophysical and biological environment as a result of the construction of the Mulungushi HPP, both upstream and downstream of the Project Area. Potential environmental impacts are presented both for the construction and operations phases.

7.1.1 Air Quality

Potential Impacts

Given the rural nature and the total lack of any heavy industry in the Project Area, ambient air quality in the Project Area is expected to be good. The Project Area is relatively far removed from sensitive receptors such as villages, clinics, schools etc. Although dust from construction activities will need to be managed and mitigated, a hydropower development will not contribute to air quality impacts during its operation. As such, it can be expected that the impacts associated with air quality will be negligible.

Further Studies Required in the ESIA Phase

It is considered that there will be no significant adverse impacts on air quality arising from the Project in the area. As such, ***no air quality specialist studies during the ESIA are deemed necessary, although standard mitigation measures will be addressed. However, the nuisance factor from air quality will be addressed in the socio-economic study.***

7.1.2 Soils

Potential Impacts

Construction Phase

Construction activities associated with the proposed Project could lead to significant soil disturbance at a number of locations, including construction of the new access road, the location of spoil heaps (from tunnelling), the new Mulugushi Power House, the workers' camp and the widening of existing roads. Given that the soils in the Project Area include acrisols, which are susceptible to erosion, soils in the Project Area could be exposed to an increased risk of soil erosion and degradation (eg through compaction) and subsequent increased turbidity and sedimentation of water courses. These risks should all be mitigated by the effective implementation of industry-standard practices for soil conservation on construction sites.

Operational Phase

In the reaches immediately downstream of dams, sediment supply is usually reduced due to the trapping of sediment in the upstream reservoir. Hydropower plants may also alter sediment transport very far downstream through alteration of the hydrology (and therefore the energy to move sediments), and this can be further exacerbated by peak daily releases (associated with peaking power generation). This may have a significant impact on the river morphology downstream of the dam, whereby patterns of erosion, transport and deposition along the river downstream to the Mulungushi HPP may gradually shift until a new *status quo* is established over time. Although sediment flows and erosion levels were affected by the construction of the existing Mulungushi hydropower station and Mulungushi Dam in the 1920s, the upgraded Mulungushi HPP will bypass the existing infrastructure, and due to the capacity of the pressure tunnel, may reduce the need to spill water from the Mulungushi Dam. This changing morphology could consequently affect river water turbidity and flow velocities, and potentially impact on riverine ecosystems, particularly between the Mulungushi Dam and Mulungushi HPP.

Further Studies Required in the ESIA Phase

There is the potential for significant adverse impacts arising directly from the soils in the Project Area. As such, ***a soils specialist has been appointed to undertake soil specialist studies during the ESIA process.***

7.1.3 Environmental Flow – Hydrology

Potential Impacts

Construction Phase

During the construction phase the exiting Mulugushi hydropower plant will operate as usual. No additional significant impacts to the river flow regime

are expected. The construction of the pressure tunnel may cause impacts on groundwater flows. As the Mulungushi River has already been impounded and the flow regime impacted from the existing Mulungushi Dam and Mulungushi hydropower plant, the downstream flow regime in the Mulungushi River would remain largely unchanged since the releases that are being proposed during construction do not provide any significant impoundment to the flow or create any significant storage that would affect the flood hydrograph.

During Operation

During normal operation of the Mulugushi Dam and especially the new Mulugushi Power Station, changes to the regulation of flows through the turbines could create a modified flow regime (including low flows, both large and small floods and flow variability) in the river downstream. This may have a significant impact on aquatic and riverine habitats downstream, affecting aspects such as bed sediments, fish and macro-invertebrates, water quality and riparian vegetation.

Further Studies Required in the ESIA Phase

There is the potential for the Project to have adverse impacts to environmental flow of the system. As such ***an assessment of downstream environmental flows*** will be undertaken as part of the ESIA. The environmental flow assessment could provide information that could allow for an optimisation of flows to minimise downstream environmental impact.

7.1.4 Downstream Water Quality

Potential Impacts

Construction Phase

The main water quality risks that occur from construction activities relate to the potential spillage of fuels, lubricants and chemicals at the construction site, and the inadequate treatment and disposal of waste and wastewater from worker compounds. These should all be mitigated by the effective implementation of industry-standard practices for safe environmental management and pollution control on construction sites. Additionally, erosion of soils into water courses causing higher turbidity could have impacts on water quality.

Operational Phase

While the main use of the Mulungushi Dam water is for hydropower generation, possible water quality impacts could affect aquatic habitats and may affect downstream subsistence fishing and/or water supplies.

Potential problems could arise from the timing of water releases to the downstream environment and the depth from which these releases are made. The water release regime may affect the temperature, oxygen concentration, sediment loads and nutrient concentrations in the release water that could in turn potentially impact on the downstream biophysical and biological environment.

Further Studies Required in the ESIA Phase

There is the potential for the Project to affect water quality and as a result have adverse impacts to downstream users; however, the extent to which the above problems occur could depend on a number of factors, including in particular the hydraulic conditions within the existing Mulungushi Dam and the degree to which circulation or thermal stratification takes place. ***As such a water quality specialist study will be undertaken as part of the ESIA.***

7.1.5 Geohydrology

Potential Impacts

Construction Phase

Apart from a localised depression in the water table due to any dewatering that could be necessary to construct new Project infrastructure foundations, there are unlikely to be any significant impacts on groundwater levels as a direct result of construction activities.

Due to the remoteness of the Project Site and the lack of any significant settlements downstream, it is unlikely that there are any existing water supply wells or boreholes in the immediate vicinity of the construction sites which would be affected by the above mentioned dewatering.

Operational Phase

The flow regime from the Mulungushi HPP affects downstream groundwater recharge rates and overall groundwater levels. The geology of the area (specifically faults and fracture zones) surrounding the Mulungushi Dam could influence the extent to which changes are experienced in the groundwater regime downstream. However, it is proposed that the current flow regime from the Mulungushi Dam remain unchanged.

Further Studies Required in the ESIA Phase

Changes to groundwater in the Project Area and surrounds will unlikely result in any socio-economic and/or environmental impacts, as the Project Area is located within a deeply incised river valley and is relatively far removed from any human habitation. As a result, the likelihood of any impacts to sensitive receptors such as boreholes in the Project Area is low. As such, ***no groundwater specialist studies during the ESIA are deemed necessary.***

7.1.6 Terrestrial and Aquatic Flora

Potential Impacts

Construction Phase

Construction of the pressure tunnel, new Mulugushi Power Station, the new access road and associated Project infrastructure could involve large equipment operations, material storage areas, and administrative space (ie construction camp etc.), which could remove and/or disturb vegetation in affected areas. This may primarily affect riparian habitats and hill-slope vegetation.

Operational Phase

Once construction activities are complete, new riparian vegetative communities should re-establish. Should the Mulungushi HPP alter the flooding regime of the river, alien vegetation may establish itself along the riparian zone. Relatively stable water levels should result in a relatively homogenous aquatic vegetation and/or wetland community along the Mulugushi Dam shoreline. Significant daily or weekly fluctuations in water levels could allow for a more diverse shoreline wetland community that thrives with periodic water level changes.

Operation of the Mulugushi HPP could reduce the amount of flow received by riparian systems downstream of the dam, which could alter the composition of riparian vegetation. River flow delivers critical nutrients, sediment, coarse debris, and other critical ecosystem components to riparian habitats. Also, riparian wetlands could become uplands due to the lack of flow.

Further Studies Required in the ESIA Phase

There is the potential for adverse impacts arising directly on both terrestrial and aquatic flora in the Project Area. As such, ***terrestrial and aquatic flora specialists have been appointed to undertake these specialist studies during the ESIA process.***

7.1.7 Terrestrial and Aquatic Fauna

Potential Impacts

Construction Phase

The noise, dust and human activity from construction activities could affect disturbance-sensitive animals and potentially result in their temporary displacement from current habitats. The construction of the new access road and upgrade of existing roads may cause fragmentation of terrestrial habitats, also causing wildlife disturbance and displacement. Displaced fauna may be subject to increased hunting pressure.

Operational Phase

Any change in the flow regime may potentially reduce or eliminate downstream floods, potentially reducing riparian wetlands and the aquatic and terrestrial fauna that spawn, rear, and/or breed in these habitats.

At present the fish community is characterised by species which have specific flow and habitat requirements, and is thus considered sensitive. The relationship between fish community and flow is complex, and may prove difficult to define. A precautionary approach will thus be to focus on suitable habitat availability during baseflow conditions. With reference to the preferred Project alternative (Alternative 1), it is anticipated that the stretch of river between the Mulungushi Dam wall and existing diversion structure will experience a more intense residual impact. The impact on the river reach between the Mulungushi Dam wall and new Mulugushi Power Station will relate to flow reduction and a possible risk of inadequate discharge to sustain existing fish communities (Ecotone and NSS, 2013).

The fish community above the Mulungushi Falls might have an additional sensitivity attribute. This community is isolated and may be providing novel genes and unidirectional gene flow to downstream communities. The river reach below the Mulungushi Power Station will experience an increase in low flow volumes, which will increase the extent of inundation and create greater hydraulic stress (Ecotone and NSS, 2013).

The possibility exists that unresolved species new to science/undescribed species, or species having have conservation status, may be found, which might classify their habitat as critical. According to the IFC performance standards, critical habitat may require an offset plan. Significant residual impacts may also require an offset strategy (Ecotone and NSS, 2013).

A number of sampled fish species are sensitive to alteration in water quality, and are likely to respond negatively to increases in silt loads, or water pollution from the construction activity. Physical and chemical differences in the Mulungushi Dam and Mulungushi River water may also impact aquatic communities during the operational phase. At present, the Mulungushi Dam wall has a spill way that allows flow from the upper epilimnion layer of the impoundment. This layer is ideal for discharge as it has comparable temperatures and higher nutrient loads than layers situated lower down in the water column. It is a concern that the proposed inlet structure will allow colder water from the hypolimnion to discharge into the Mulungushi River, as this will likely impact the receiving fish communities (Ecotone and NSS, 2013).

With regard to the macro-invertebrate diversity and species richness, any alteration of flow volumes or water quality (such as a change in turbidity and temperature) within the river downstream of the Mulungushi Dam wall towards the new Mulungushi Power Station will have an impact on species composition within the river. The increase in the flow downstream of the

power station will also have impacts on the macro-invertebrate assemblages (Ecotone and NSS, 2013).

Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from terrestrial and aquatic fauna in the Project Area. As such, ***a terrestrial fauna and an aquatic fauna specialist have been appointed to undertake these specialist studies during the ESIA process.***

7.1.8 Terrestrial and Aquatic Habitats

Potential Impacts

Construction Phase

Effects on terrestrial habitats during construction relate to the loss or disturbance of riparian and other vegetation in the immediate vicinity of construction activities, as is described in *Section 7.1.6*. The loss or disturbance of riparian vegetation could cause increased river bank erosion in the vicinity of the construction activities. Large equipment operations and equipment lay-down could remove and/or disturb vegetation, potentially facilitating erosion of disturbed soils and compacting soils, thus increasing runoff velocity and erosion of down-gradient habitats.

Effects on aquatic habitats during construction of the Project relate to the diversion of surface flows, increased sedimentation and the direct loss and disturbance of in-stream aquatic habitats in the immediate vicinity of construction activities. These construction-related effects on aquatic habitats should be localised and smaller in magnitude compared to the operational effects of the Project.

Operational Phase

Alterations of depth and flow regimes may alter the surface water temperature within and downstream of the affected reach. Increased water temperature can affect the suitability of aquatic habitats for fish and macro-invertebrates and potentially cause a shift in species composition to more generalist species that are tolerant of a wide range of temperature conditions.

Natural flow regimes are important factors in determining the morphological characteristics, and thus the habitat value, of natural river channels. Habitat-forming flows often correspond to high-volume flows during flood events. Operation of the dam (ie flow releases) could limit the magnitude or duration of downstream high flow events and this could retard the natural progression of aquatic habitat formation in the river and potentially result in changes in species composition, density, and diversity of aquatic fauna downstream of the Mulungushi Dam.

Operation of the Mulungushi HPP may also interrupt natural sediment transport mechanisms, especially for coarse gravel and cobble, and the availability of course substrate downstream of the dam could decline. The depletion of coarse substrate reduces fish spawning habitat and substrate for invertebrates (macro-invertebrates, molluscs, and crustaceans).

Further Studies Required in the EIA Phase

There is the potential for adverse impacts arising directly from both terrestrial and aquatic habitats in the Project Area. As such, the appointed ***terrestrial flora, terrestrial fauna and an aquatic flora and fauna specialists have been appointed to undertake specialist studies during the ESIA process.***

7.1.9 Summary

In summary, the following environmental affects and/or potential negative environmental impacts associated with the Mulungushi HPP are deemed to be the most significant and will need to be assessed further in the ESIA process:

- A potential change in *downstream river morphology due to sediment transport*, which in turn could consequently affect river water turbidity and flow velocities, and hence potentially impact on riverine ecosystems.
- A *modification to downstream flow volumes* may have a major impact on aquatic and riverine habitats downstream from the Mulungushi Dam. Downstream flow volumes will be modified, as upstream flows will be captured in the Mulungushi Dam.
- There is the potential for the Project to affect *water quali*ty and as a result have adverse impacts to downstream users.
- Potential impacts to *terrestrial and aquatic fauna* as a result of disturbance and displacement during the construction and operational phase of the proposed Project.
- *Habitat conversion*, which may alter the species assemblage.
- Impacts *to soils* and subsequent impacts to downstream water quality as result of increased turbidity and sedimentation as well as to *land capability* and the communities reliant on these soils for subsistence agriculture.

7.2 POTENTIAL SOCIO-ECONOMIC IMPACTS

This section describes the potential impacts to the social and socio-economic environment as a result of the construction and operation of the Project. Potential social and socio-economic impacts are presented both for the construction and operations phases of the proposed Mulugushi HPP.

7.2.1 Surrounding Landuse

Potential Impacts

The proposed Mulugushi HPP and ancillary infrastructure (roads) has the potential to affect current landuse practices within the proposed Mulugushi

HPP Project Area and surroundings, specifically small shops or stalls found along the length of the D421 road. This impact will, however, be minimal as most of the Project activities will occur within the Project Site. The proposed new road to access the new Mulungushi Power Station also falls within LHPC owned land.

Further Studies Required in the ESIA Phase

There is the potential for the proposed Project to impact on surrounding land use. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.***

7.2.2 *Loss of Natural Resources*

Construction Phase

There is a possibility that land may be lost due to the construction and presence of the following Project components:

- *Construction camp and laydown area:* During the construction of the pressure tunnel and Mulungushi Power Station, area for a construction camp and laydown area may need to be cleared. It is likely that construction workers will be housed at Mulungushi Village.

- *Access road to* Mulungushi Power Station*:* During the construction of the new access road to the Mulungushi Power Station, vegetation will be cleared. The precise route of the road has yet to be determined.

- *Construction of the* Mulungushi Power Station*: The contruction of the* Mulungushi Power Station will require vegetation clearance.

The socio-economic impact of the loss of vegetation as a consequence of land take will, however, be minimal as most of the Project activities will occur within the Project Site. The proposed new road to access the powerhouse also falls within LHPC owned land.

The construction phase will require a number of skilled, semi-skilled and unskilled workers, many of whom are likely to come from communities surrounding the Project Area due to a lack of locally skilled labour. The size and make-up of this workforce is not yet determined. However, the presence of large numbers of workers in the ProjectArea may result in an increased demand for firewood, bush meat, fish, charcoal, and other natural resources from the surrounding riparian forests, open woodlands and rivers.

Further Studies Required in the EIA Phase

There is the potential for loss of land and natural resources arising directly from the footprint of the proposed and ancillary Projects. As such, ***socio-economic and flora specialists have been appointed to undertake specialist studies during the ESIA process.***

7.2.3 *Pressure on Natural Resources and Social Infrastructure Associated with In-migration*

Construction Phase

The prospect of employment (real or perceived) may attract job seekers to the Project Area. Communities surrounding the Project Area suffer from inadequate schooling and health facilities, a shortage of potable water and transport facilities, and an inadequate road network. An influx of job seekers and construction workers could place a greater strain on these already limited facilities and infrastructure.

In addition, the presence of large numbers of workers in the Project Area may result in pressure on natural resources such as firewood, bush meat, fish, charcoal, and other natural resources from the surrounding area. This may, in turn, lead to increased competition for natural resources, resulting in social tension.

Further Studies Required in the ESIA Phase

There is the potential for social infrastructure to be negatively impacted on as a result of the Project. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.***

7.2.4 *Impacts on Community Health*

Construction Phase

Key communicable and other diseases that may be affected by the presence of the Project during construction are:

- acute respiratory infections and tuberculosis (TB);
- HIV/AIDS, Hepatitis B and C, and other sexually transmitted infections; and
- Malaria.

There is a risk that the workforce employed during the construction period of the Project could impact the local communities' health status. Groups vulnerable to health impacts would include young children, the elderly, the socio-economically deprived, and groups with chronic health conditions. The origin, size and health status of the workforce (some of whom could be recruited outside of Zambia), and their cultural norms, could influence the nature and severity of these risks.

A significant increase in traffic levels combined with other factors including poor current road conditions, uneven surfaces and the limited understanding of road safety among local drivers and pedestrians is likely to increase the number of accidents.

Operational Phase

Communicable diseases may appear or increase in incidence owing to the influx of migrants to the area.

Increased mosquito activity resulting from construction actions may also have harmful effects on populations adapting to the new environment. There are also likely to be socio-demographic changes associated with changes in reproductive behaviour and women's activities.

Further Studies Required in the EIA Phase

There is the potential for community health to be negatively impacted on as a result of the proposed Project. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.***

7.2.5 Impact on the Local Economy

Construction Phase

There may be high expectations with regards the benefits that people expect could accrue from the presence of the Project and the increase in numbers of waged workers to whom local people could sell goods and services. The potential impacts are summarised below.

- *Employment during construction:* The construction of the Project could take place over four years, requiring a sizable workforce, although much of the construction phase will be mechanised. It is not clear at this stage what skill types could be required, or the extent to which employment opportunities could be created in the Project Area. The benefits to the local community from jobs could be dependent on the extent of local recruitment.

- *Local procurement during construction:* The construction phase will generate contracts for the purchase of equipment and other goods and services. While many of these contracts will be for specialist goods and services, there is likely to be some potential for procurement from businesses at the local and provincial levels, which will be significant for the local economy.

- *Increase in the local prices:* There could be a significant, though short-term improvement in the local economy (for example due to local procurement of supplies and services by the construction camp). However, there could also be an increase in the price of local goods, which could make life more difficult for those vulnerable sectors of society that are unlikely to benefit from the construction phase and are already economically strained.

- *Unmet expectations for employment and procurement:* There may be high expectations amongst the local community in terms of employment associated with the Project. However, the level of mechanisation during the construction phase, together with the skills level required may limit

the extent to which they are able to benefit from employment opportunities. This is particularly true for women in the Project Area. This could have an impact on relations between the Project and populations who feel excluded from the Project benefits.

Further Studies Required in the ESIA Phase

There is the potential for the local economy to be negatively impacted on as a result of the proposed Project. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.***

7.2.6 Impacts on Fishing (Downstream)

Construction Phase

The change in the flow regime and possible silting of the river downstream could result in a decline in fish resources. The extent to which the directly affected communities downstream of the proposed Mulungushi Dam utilise fish as a main source of food must still be determined.

During the operation phase, it is assumed that the river will return to current flow regimes.

Further Studies Required in the ESIA Phase

There is the potential for local fishing to be negatively impacted on as a result of the Project. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.***

7.2.7 Disturbance Due to Dust, Noise and Safety Hazards from Traffic

Construction Phase

The construction of the Project infrastructure could require building material and other supplies (fuel, supplies to the construction village etc.), all of which will be delivered to the Project Site by trucks that are likely to pass by homesteads. The road to the Project Site is unpaved and the traffic through these homesteads could result in disruption from dust and noise from passing traffic. Due to the rural nature of potential homesteads, they may not be familiar with these types of traffic conditions, increasing their susceptibility to disturbance. Safety could also be an important issue for residents who are unused to much traffic.

There are a number of other issues related to road widening and use. Firstly, there are a number of locations where arable land will be lost to these communities as a result of road widening. There are also several permanent structures which need to be moved. Although the footprint of this is likely to be limited, affected parties will need to be compensated for any costs incurred to purchase new land or move structures. Secondly, during the construction and operational phase the possible use of the Mulungushi Road and Mulungushi Bridge by heavily loaded trucks transporting manganese ore from a nearby mine is of concern. When the alternative road is flooded

or in poor condition, the truck drivers are reported to make use of the Mulungushi Road, which is maintained by the Lunsemfwa Hydro Power Company Limited (LHPC). Originally the Mulungushi Bridge was designed to carry 30 tonnes, but was later reinforced to 60 tonnes during the Mulungushi upgrade. The bridge will also be improved or replaced before the project.

Further Studies Required in the ESIA Phase

There is the potential for local communities to be negatively impacted on as a result of the Project. As such, a ***socio-economic specialist has been appointed to undertake specialist studies during the ESIA process.*** Dust and noise issues associated with traffic will be mitigated as much as possible through the careful routing of access roads and inclusion of appropriate measures in the relevant EMP and detailed Management Plans. As such, and as already mentioned, specialist air quality and noise studies are not deemed a requirement.

7.2.8 Secondary Impacts

There are a number of potential secondary impacts from the Project that need to be considered in the ESIA. Should the Mulugushi HPP result in improvements to the D421 road, it could improve access to Mulugushi Dam. This could, in turn, lead to an increased number of people accessing the area for fishing, placing strain on fish stocks.

7.3 CUMULATIVE IMPACTS

Evaluation of potential cumulative impacts is an integral element of an impact assessment. In reference to the scope for an impact assessment, IFC's Performance Standards specify that:

*"Risks and impacts will be analyzed in the context of the project's area of influence. This area of influence encompasses…**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; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.* "(IFC 2006).

Cumulative effects have been defined as "*changes to the environment that are caused by an action in combination with other past, present and future human actions*" (Hegmann *et al* 1999).

There are a number of hydropower plants proposed for the Lunsemfwa River Basin. While one project may not have a significant negative impact on sensitive resources or receptors, the collective impact of the projects may increase the severity of the potential impacts. Cumulative impacts will be considered in the ESIA both temporally and spatially. Potential cumulative impacts identified at this stage include:

- Changes in river flow regimes across the Lunsemfwa River Basin;
- Water quality issues across the Lunsemfwa River Basin;
- Biodiversity impacts across the Lunsemfwa River Basin;
- Impacts on natural resource use by local communities; and
- Impacts on local community agriculture.

7.4 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY

All potentially significant environmental impacts (physical, biological, socio-economic and cultural and heritage) associated with the Project have been identified in the Scoping Study and (where applicable) will be further investigated and assessed within the ESIA study through specialist studies. Where required, mitigation measures will be proposed.

The ESIA will suitably investigate and address all environmental issues in order to provide competent authorities with sufficient information to make an informed decision regarding the Project.

7.4.1 Aim of the Environmental Impact Assessment

The ESIA will aim to achieve the following:

- Provide an overall assessment of the physical, biological, socio-economic and cultural and heritage environments affected by the Project;
- Assess the Project Area in terms of its environmental criteria;
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive public participation process.

The adequate assessment and evaluation of the potential impacts and benefits that will be associated with the proposed Project necessitates the development of a scientific methodology that will reduce the subjectivity involved in making such evaluations. A clearly defined methodology is used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. For this the Project must be considered in the context of the surrounding area and the people that will be affected.

Nonetheless, an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and ESIA practitioners. The evaluation of significance is thus contingent upon values, professional judgement, and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

The purpose of impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and resources

according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise, reduce or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation.

There are a number of ways that impacts may be described and quantified. An impact is essentially any change to a resource or receptor brought about by the presence of the Project component or by the execution of a Project related activity.

The nature of the Project may determine whether one needs to assess both routine and non-routine impacts. Non-routine impacts generally relate to accidents and could include oil/chemical/fuel spills, emergency venting of noxious gases, etc.

7.4.1 Assessing Impacts

Table 7.1 Defining Impact Characteristics

Characteristic	Definition	Designation
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	Measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

A definition of each impact characteristic is provided to contextualise the requirements. The designations for each of the characteristics are defined below.

Table 7.2 Designations for Characteristics

Designations	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	Defined on a resource/receptor-specific basis
Regional	
International	
Duration	
Temporary	Defined on a resource/receptor-specific basis
Short-term	
Long-term	
Permanent	

The terminology and designations are provided to ensure consistency when these characteristics are described in an Impact Assessment deliverable.

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, accidental 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.

Table 7.3 Definitions of likelihood

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.

Assessing Significance

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. Magnitude is a function of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency
- Likelihood (for unplanned events only)

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor. The magnitude designations are as follows:

- Positive
- Negligible
- Small
- Medium
- Large

The 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.

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 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 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
- High

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact. The following provides a context for defining significance.

Table 7.4 Context for Defining Significance

• 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 IA 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 remaining even 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.

Based on the context for defining significance, the impact significance rating will be determined, using the matrix below.

Table 7.5 Impact Significance Rating Matrix

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Not Significant	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

7.4.2 Mitigation Potential and Residual Impacts

Once the significance of a given impact has been characterised using the above matrix, 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).

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.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described below.

Table 7.6 Mitigation Hierarchy

• **Avoid at Source; Reduce at Source:** avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
• **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).
• **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).
• **Repair or Remedy***:* some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
• **Compensate in Kind; Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

7.5 CONSIDERATION OF ECOSYSTEM SERVICES

Ecosystem services are the services provided by an ecosystem functioning with human use value, and are generally categorised as follows:

- ***Provisioning Services:*** The extent and frequency that the land unit provides consumable goods (eg food, freshwater; timber, fibre, medicinal plants, etc.);
- ***Regulating Services:*** The extent to which the land unit provides regulating services such as flood attenuation, water purification; storage, climate regulation, carbon sequestration, etc.;
- ***Cultural Services:*** The extent to which the land unit provides cultural services (eg tourism attraction; spiritual attraction; aesthetic value, etc.); and
- ***Supporting Services:*** The extent to which the land unit provides supporting ecological services, either positive (eg migration corridor; refuge area; primary production; pollination; pest control; nutrient cycling; soil formation), or negative (eg disease sources; pest outbreaks).

A detailed overview of potential ecosystem services would be undertaken by the specialist team and presented in the ESIA Report.

8 ANALYSIS OF ALTERNATIVES

This *Chapter* briefly discusses the various hydropower alternatives that have been investigated for the proposed Mulungushi Hydropower Plant (Mulungushi HPP), and the motivation for choosing the preferred Project alternatives, including any environmental considerations. Where a single Project alternative has yet to be selected, the details of existing alternatives will be provided.

In the case of the Mulungushi HPP, a number of types of Project alternatives have been considered:

- Mulungushi HPP Layout
- Access Road
- Type of Powerhouse
- Type of Turbine

8.1 MULUNGUSHI HPP LAYOUT ALTERNATIVES

Lahmeyer International (LI) consulting engineers developed four alternative layout designs for the Mulungushi HPP being proposed by the Lunsemfwa Hydro Power Company Limited (LHPC). These included various above- and below-ground configurations which differed in their use of existing infrastructure, cost, and use of the Mulungushi River canal (*Table 8.1*).

Alternative 1 (*Figure 8.1*) was selected due to its greatest net benefit (input costs relative to their power generation capacity). Not only does Alternative 1 have the largest net head (energy generation potential due to the distance the water drops), and the highest average annual energy generation, but has the lowest maintenance costs, and is the only alternative that does not interrupt power generation from the existing Mulungishi Hydropower Station (approximately 30MW). As an additional benefit, Alternative 1 does not require the 3.9MW 'discharge unit' envisaged at the diversion tunnel at the dam.

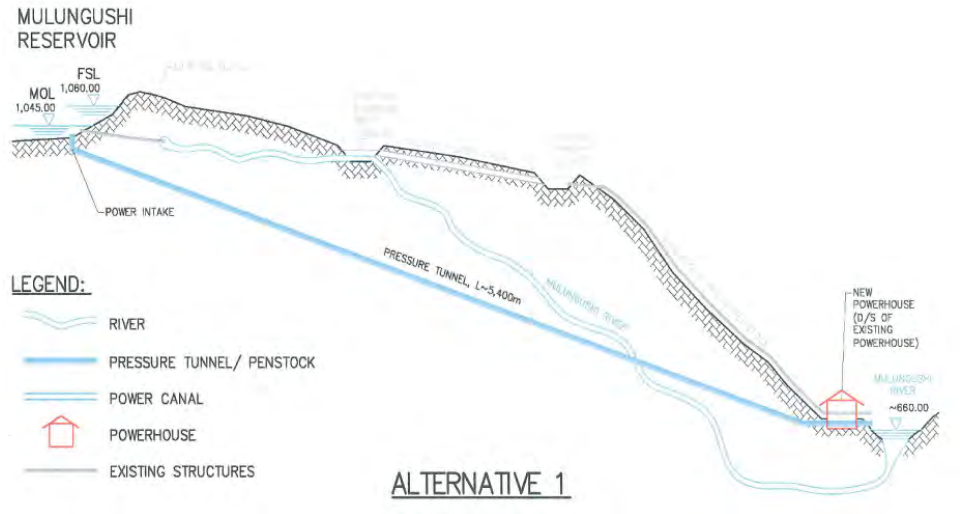
Table 8.1 Comparison of Project Alternatives

	Pressure Tunnel Length (m)	**3.9MW Discharge Unit (Y/N)**	**Use of Diversion Dam**	**Power Canal (Y/N)**
Alternative 1	5400	N	N	N
Alternative 2	3209	Y	Y (enlarged)	N
Alternative 3	1288	Y	Y	Y
Alternative 4	-	Y	Y	Y (inc. new Penstock + enlarged Forebay)

As noted in *Chapter 3*, Alternative 1 will involve the drilling of a 5.4km pressure tunnel from the Mulungushi Dam directly to the new Mulungushi

Powerhouse which will be built adjacent to the existing Powerhouse approximately 400m downstream. This Project alternative was considered as the geology of the Mulungushi Study Area is characterized by a gneiss formation that is well suited to underground engineering solutions such as the selected pressure tunnel. Water from the Mulungushi Dam will be fed into a power intake that connects to the upper end of the pressure tunnel. The pressure tunnel drops approximately 350m over the 5.4km to the new powerhouse. Although Alternative 1 is the most costly Project alternative to construct due to the extent of drilling required, it does not require additional investment in the expansion of the existing canal, spillway of the Forebay, or the installation of a discharge unit, which would be needed to different degrees in the other Project alternatives.

Figure 8.1 Mulungushi HPP Cross-sectional Layout (Alternative 1)



Source: Lahmeyer International (2013)

8.2 *ACCESS ROAD ALTERNATIVES*

Two access alignments were considered for the permanent road linking the Mulungushi village and the new Mulungushi Powerhouse at the bottom of the gorge (green lines in *Figure 8.2*).

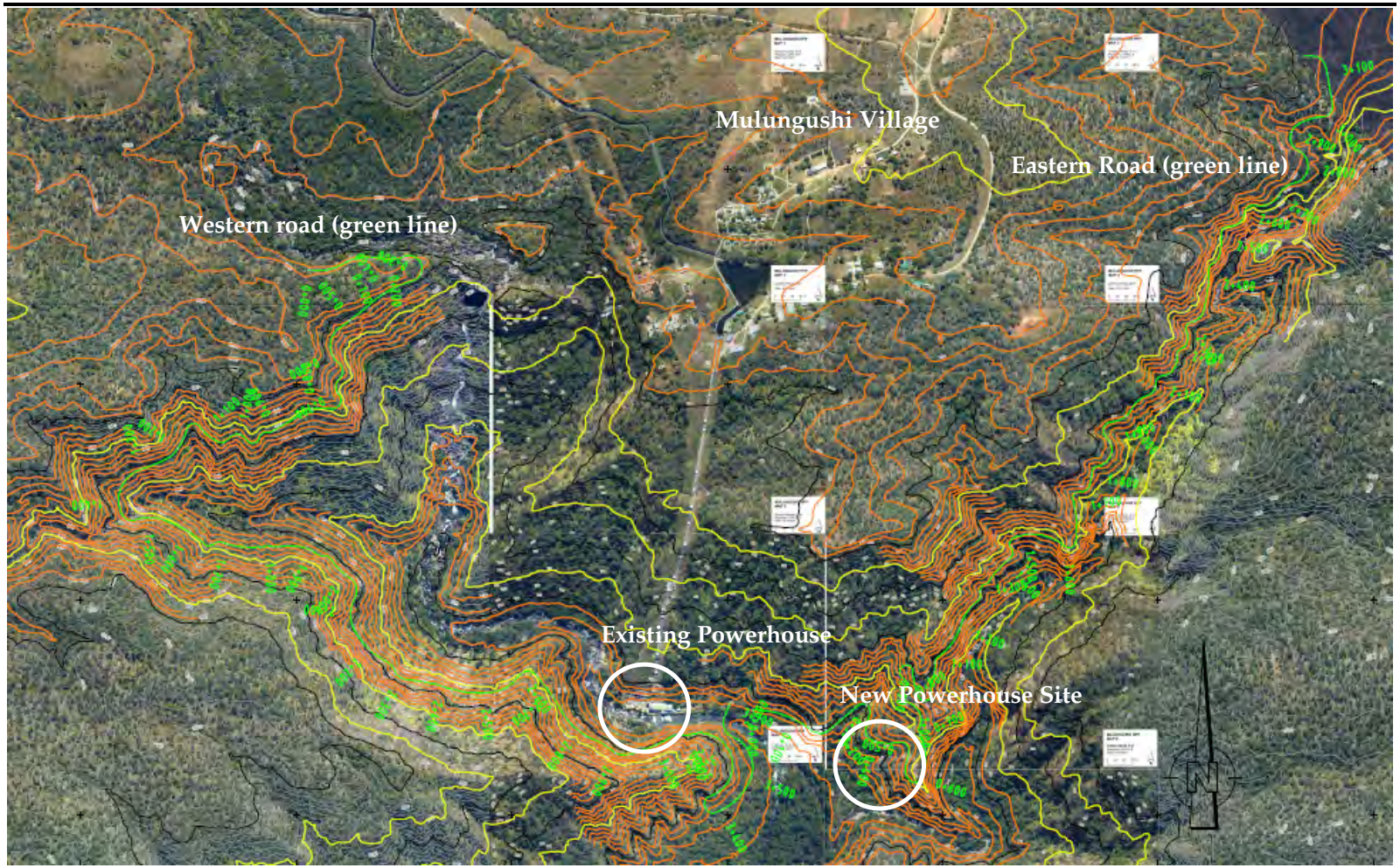
The selected eastern access road route alternative links to a road junction on the eastern side of the Mulungushi village and follows an eastward track to the edge of the Katobo River gorge. It then runs parallel to the Katobo River, gradually dropping into the gorge until its confluence with the Mulungushi River. The distance from the road junction to the new Mulungushi Powerhouse would be approximately 4.5km, and the road would have a maximum gradient of 13 percent.

The western access road route alternative would have begun at the existing road to the north-west of the Mulungushi village, extending via a bridge over

the canal and two bridges over the Mulungushi River, before arriving at the new Mulungushi Powerhouse. Overall, the road would be approximately 6km in length.

Initial quantity estimates show that cut and fill volumes of both access road alternatives would be comparable. The eastern access road alternative alignment down the mid-slopes of the Katobo River gorge has been selected as the preferred alternative as it is shorter and requires no bridges over the Mulungushi River or the existing canal. As the road will be a permanent road to provide access for operation of the Project, its closer proximity to the Mulungushi village is preferable compared to the significantly longer route down the right bank of the Mulungushi River via three bridges.

Figure 8.2 ***Access Roads (the green lines to the east and west of the existing power station). Please note that both alignments as shown are incomplete in their upper reaches.***



Source: Lahmeyer International (2013)

8.3 TYPE OF POWERHOUSE AND TURBINES

Two Project alternatives were considered for both the powerhouse and turbines.

Space is available for both surface or cavern powerhouse designs on the left bank of the Mulungushi River between the existing powerhouse and its confluence with the Katobo River. However, a surface powerhouse is preferred the preferred alternative.

The choice of turbines was between the Francis and Pelton types, which vary in their head size and efficiency curves. Two 40-50MW Francis turbines (total output 80-100MW) were selected. Compared to the Pelton turbines, the Francis turbines utilize a slightly larger head, and have a slightly higher efficiency.

8.4 SUMMARY OF PROJECT ALTERNATIVES

The Project alternatives selected to be carried forward into the actual assessment phase of this ESIA, namely a pressure tunnel the entire distance between the reservoir and the new powerhouse, the eastern access road alignment, the surface powerhouse and the Francis-type turbines, were subjected to a high-level evaluation from an environmental perspective. Each of them showed that environmental constraints had been responded to, albeit from an engineering or cost perspective, and no obvious fatal flaws are apparent. This is appropriate to the Scoping phase of the ESIA for the Mulungushi HPP. More detailed design and mitigation alternatives will be examined during the assessment phase to follow.

9 PLAN OF STUDY AND EXPERTISE REQUIRED FOR THE STUDY

As per *Chapter 7*, *Sections 7.1 and 7.2*, it is anticipated that the following key environmental and socio-economic aspects will be impacted by the Project:

- Soils;
- Terrestrial flora and fauna;
- Environmental flows and aquatic ecology;
- Socio-economic impacts; and
- Archaeology and cultural heritage.

These aspects will be further investigated and assessed within the ESIA phase through specialist studies. The ESIA will suitably identify, investigate and address all environmental and socio-economic issues in order to provide the authorities with sufficient information to make an informed decision regarding the Project.

After this scoping phase, it is proposed that potential air quality and noise impacts resulting from the Project would be insignificant, primarily as a result of the Project location (its isolation) and the lack of any sensitive receptors in the Project Area. In addition, visual impacts associated with the Project will not be significant, as the Mulungushi HPP is an upgrade of the existing Mulungushi hydropower station and is far removed from any human inhabitation. As a result, it is proposed that air quality, noise and visual aspects be scoped out of the ESIA at this early stage.

As per the requirements of the EMA (Act 12 of 2011) Regulations (No. 28 of 1997), this *Chapter* also introduces the Project Proponent, who will be the applicant on behalf of the Mulungushi HPP for environmental authorisation for the Project. The ESIA team, responsible for the next phase of the study (namely, the ESIA phase), are also presented in this *Chapter*.

9.1 SPECIALIST INVESTIGATIONS

Information obtained through available secondary data provided an overview of the environmental and socio-economic aspects of the Project Area. The objective of specialist input at this scoping stage is to validate the secondary data obtained, to identify any gaps in data, and to suggest a plan of study for the ESIA. This plan of study is aimed at addressing any data deficiencies that exist in order that comprehensive specialist studies may be carried out to properly assess and address those environmental and socio-economic impacts identified.

The following specialist studies are proposed during the ESIA phase of the Mulungushi HPP:

9.1.1 Soils

This study is set out to identify and determine the presence, distribution and extent of soil types in the Project Area. The objectives relate directly to land capability while land use aspects will be covered primarily by the socio-economic study.

Soil Sample Testing and Mapping

A total of 18 soil samples at 9 sites have been collected and will be subjected to a number of laboratory tests. The soils will be analysed in order to determine the following:

- particle size distribution; and
- soil fertility and sodicity.

Analysing the results of the tests and spatial investigations (*inter alia* the creation of sampling and soil maps) will also be undertaken in this phase.

Land Use Capability Assessment

The land use capability assessment will involve rating the Project Area according to its limitations, either in a permanent or temporary basis. Soil information will be combined with climate, topographic and land type datasets in order to provide a spatial classification of the land based on its soil characteristics and land use capability.

9.1.2 Terrestrial Flora and Fauna

The objective of this specialist study is to characterise the current terrestrial flora and fauna baseline of the Project Area and assess the impacts on terrestrial flora and fauna as a result of the Project. The terrestrial flora and flora studies will entail a desktop review of existing readily available information relating to the Project Area, which shall be validated through field surveys in the Project Area to provide a robust baseline description. The baseline will provide the foundation for identifying and assessing the impacts of the Project and recommending mitigation measures (including monitoring, where required).

Desktop Study and Analysis of Secondary Data

The desktop study and analysis of secondary data will include:

- Botanical reports and readily available data for the Project Area;
- Use of satellite derived vegetation mapping ;
- Relevant reports and data on fauna of the Project Area;
- Review of the terrain and land cover types; and
- Determination of field survey areas and requirements.

Field Survey

A field survey will be undertaken to cover the following aspects:

- Terrestrial flora;
- Aquatic flora, specifically possible presence of *Leiothylax drummondi*, a Red Data species, should river flow levels permit;
- Birds;
- Herpetofauna; and
- Mammals.

As part of the field survey, foot surveys in the proposed footprint of the Mulungushi HPP (including roads and pipeline corridors) and immediate downstream area that may be influenced by flow changes will be undertaken. The following shall be recorded:

- Habitat and vegetation types (confirmation of existing vegetation mapping with descriptions of habitats, floral diversity and characteristic species present);
- Observations of presence and extent of alien species;
- Assessment of the various faunal communities present within the study area based on sightings, evidence of their presence, reported presence by communities or people familiar with the area or potential presence based on suitability of the habitat;
- Assessment of the presence or potential presence of Conservation Important (CI) floral and faunal species which would include Red Data, nationally protected, rare, migratory, range restricted species and species that underpin ecological services; and
- Observations of evidence of human use of flora or fauna (e.g. charcoal, wood cutting, hunting/snares, grazing animals in woodland etc.).

9.1.3 Environmental Flows

There is no standard definition for environmental flows, however a good general description is provided by the International Union for Conservation of Nature's (IUCN) pre-release to the 3rd World Water Forum in Kyoto, as follows:

"An 'environmental flow' is the provision of water within rivers and groundwater systems to maintain downstream ecosystems and their benefits, where the river or groundwater system is subject to competing water uses and flow regulation."

Environmental flows are therefore more than minimum flows defined on the basis of hydrological conditions. Rather, they are flows that are optimally designed to allow for the multipurpose use of water, including water's ecological functions and the integrity of river systems and wetlands. These functions, or 'ecosystem services', include the provision of clean drinking water, biodiversity conservation, aquatic food sources, flood protection, and various other recreational, cultural or religious based uses. This proposed

Project, which involves the regulation of flow by infrastructure, should therefore avoid significantly altering flow regimes and preventing water resources from fulfilling these important functions and services.

Although there are various methods for undertaking Environmental Flow Assessments (EFAs), they fall into four discrete groups, namely hydrological index methods, hydraulic rating methods, habitat simulation methods, and holistic methodologies (Acreman and Dunbar, 2004).

The chosen EFA method should incorporate an integrated assessment of environmental, social and economic effects and benefits. The EFA methodology to be adopted should be scoped according to the levels of environmental and/or socio-economic risk, available data and expertise, and time and budget constraints. This selection process should be undertaken as part of this scoping process to allow for an open and transparent process of stakeholder engagement and discussion.

The EFA for the Mulungushi project will consider the present ecological state and the ecological extent of existing hydrological impediments. The necessity for a conventional holistic EFA on the Mulungushi River was considered superfluous and an adaption thereof is recommended. The recommended approach will be risk based and will not produce the typical discharge recommendations associated with an EFA. The main objective of the recommended approach will be to assess the impacts on aquatic ecology caused by discharge variations induced by the proposed development. This approach will include two main components:

- Species attributes- Identification of species (fish, aquatic macroinvertebrates, periphyton, riparian vegetation) sensitive to alteration in hydrology; and
- Habitat availability- Quantitative assessment of available instream habitat as is expressed by substrate, cover and hydraulic units (i.e. fast, slow, shallow, deep).

The presence of sensitive species will be used to assess impact severity, while the loss of habitat supporting sensitive species will be used to assess impact probability.

This methodology is selected at this phase of the Project and is deemed acceptable based both on an initial understanding of environmental and social risks, the relative lack of readily available flow data at present from the Mulungushi Catchment, and the fact that the Mulungushi Catchment is already regulated by the Mulungushi Dam.

9.1.4 Aquatic Ecology

The objective of this specialist study is to determine the baseline aquatic ecological status of the Project Area. This data will be used to assess the ecological health of the rivers in the Mulungushi Catchment within the Project

Area, against which future monitoring can be carried out in order to quantify impacts as a result of the Project.

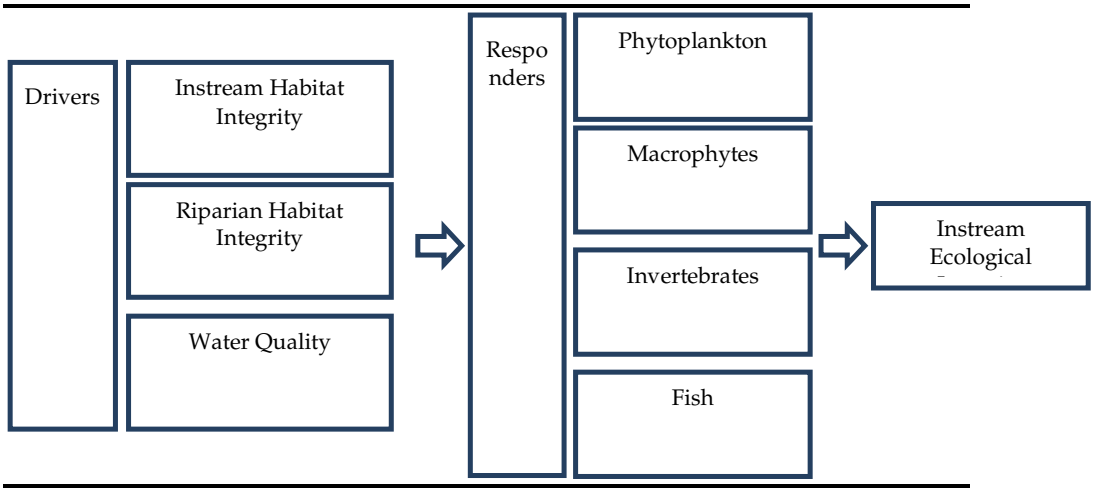
The temporal and spatial variation in instream and riparian conditions of the rivers in the Mulungushi Catchment will be addressed. Significant biological and physico-chemical impacts will be identified and assessed in an appropriate amount of detail. The aquatic ecology study will encompass the following tasks:

- Biannual assessment of the instream conditions at no less than five strategically selected sites.
- Characterisation of the aquatic environment, the aquatic habitat and related biota including the following:
    - Response metrics:
        - Diatoms Assessment (Taylor *et al.*, 2005).
        - Aquatic macro-invertebrate Assessment.
        - Fish Assessment.
        - Riparian Assessment.
    - Drivers:
        - Habitat Indicators (IHAS and IHI - McMillan, 1998; Kleynhans, 1999).
        - Ecological Hydraulic Unit Assessment (quantifying the physical extent of available habitat as defined by depth, substrate and flow conditions for each site assessed).
        - Channel profile modelling based on 5m contour lines. This will aim to quantify the increase or decrease in the lateral extent of water due to the proposed activity.
        - Water quality measurements.
- Reporting will include:
    - Report on high flow baseline conditions and preliminary sensitivities, risks and concerns.
    - Integrated report on the spatial and temporal variation in instream conditions between high and low flows.
    - Risk assessment based on the variation in habitat and sensitivity of affected aquatic communities.
    - Relevant input into the EMP.

Rationale

Any comprehensive aquatic ecology assessment should account for facets of instream ecological integrity as well as their cause and effect relationship (*Figure 9.1*). This section provides a breakdown of each "driver" and "response" component, and discusses site and method selection, sampling frequency, data processing, interpretation and dissemination.

Figure 9.1 ***Separate Facets of Ecological Integrity, Highlighting Metrics that should be included in a Comprehensive Aquatic Assessment***



Source: Kleynhans and Louw, 2006

Driver Metrics

Driver metrics consist of three main components, these include geomorphology, hydrology and water quality. Changes in geomorphology and hydrology are often the result of catchment scale impacts and, in some instances, are difficult metrics to assess. As a result a habitat integrity surrogate is proposed for these two metrics. Both the habitat integrity and water quality drivers are discussed in this section.

Habitat Integrity and Water Quality

The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale. These conditions are comparable to the natural characteristics and habitats of a region. The habitat integrity assessment is approached from an in-stream habitat and riparian zone habitat perspective. The assessment is based on an interpretation of the deviation from the reference condition. Information on changes to reference conditions are interpreted in terms of modification and relate to the drivers of the system; namely hydrology, geomorphology and physico-chemical conditions.

The In-stream Habitat Integrity Assessment will be based on five metric groups, namely:

- Hydrological modification
  - Base flow;
  - Zero flow; and
  - Floods.
- Physico-chemical modification
  - pH;
  - Nutrients;

    - Water temperature;
    - Water clarity;
    - Oxygen concentration; and
    - Toxics.
- Bed modification
    - Sedimentation; and
    - Benthic growth (algal).
- Bank modification
    - Marginal characteristics; and
    - Non-marginal characteristics.
- Connectivity modification
    - Longitudinal; and
    - Lateral

The Habitat Integrity Category will be determined (ie unmodified or natural to critically modified). Baseline conditions will be established against which future assessments could be compared.

Water Quality

In-situ water quality data including pH, temperature, dissolved oxygen, Total Dissolved Solids (TDS) and electrical conductivity will be analysed for at each site.

Water samples will be collected and analysed for the following variables: pH, electrical conductivity, TDS, total alkalinity, chloride, sulphate, nitrate, ammonium, orthophosphate, chemical oxygen demand (COD), suspended solids (SS), turbidity, total hardness as well as an OES-MS metal scan for all metals some of which include fluoride, nitrite, calcium, magnesium, arsenic, sodium, potassium, aluminium, iron, manganese, total chromium, copper, nickel, cobalt, cadmium and lead.

Response Metrics

Phytoplankton

Diatoms are microscopic, unicellular algae and are used as indicators of water quality as they respond rapidly to specific physico-chemical conditions in water. Diatom laboratory procedures will be carried out according to the methodology described by Taylor *et al.* (2005). Index scores will be calculated using the OMNIDIA ver. 4.2 program. The indices used will include the Percentage of Pollution Tolerant Valves (%PTV).

Aquatic Macroinvertebrates

Aquatic macro-invertebrates live on the bottom of rivers and are for most of their lives immersed in water. The quality of the water will therefore have an impact on their health and survival. Natural adaptations ensure different tolerance and reactions to disturbance and pollution. The composition of an

in-stream community can therefore be used as an indicator of the water quality and more specifically the ecological condition or health of the river at a specific site.

A suitable method to sample aquatic macro-invertebrates will be identified by the specialist. This method will measure the changes in the benthic community in response to changing water quality and other conditions in the river. It will therefore be a direct measure of the effects of changing conditions in the invertebrate community.

Fish

Fish communities possess numerous characteristics that render them important in the assessment of ecological integrity (Karr, 1980; 1981). The cause-effect relationship between particular drivers (velocity-depth classes, cover, flow modification and water quality) and fish responses will highlight an impact on fish assemblages induced by the proposed activity. When this data is subjected to a multivariable analysis, the output provides a base from which spatial and temporal changes in fish communities may be observed and will serve to highlight specific fish responses to specific driver components. This in turn will aid in establishing the overall impact of proposed activity and assist in establishing the ecological integrity of the system. The fish assessment should at the very least include the following variables: species richness and composition, abundances, trophic occupation, habitat and flow preferences, general health and conservation status. A description of quality and relative quantity of fish habitat available at each site will be undertaken by assessing and identifying hydraulic units.

Riparian Assessment

The Riparian Zone Habitat Integrity will be based on three metric groups, namely:

- Habitat modification
  - Baseflow;
  - Zero flow;
  - Moderate flows and freshes; and
  - Floods.
- Bank structure
  - Marginal; and
  - Non-marginal.
- Riparian zone connectivity
  - Lateral; and
  - Longitudinal.

Site Selection

Site selection will consider habitat availability and river reach representation. Particular emphasis will be placed on the presence of different velocity-depth classes and the presence of diverse habitat. Even though all biotopes may not

be represented at a particular site, it is important that selected sites consist of similar biotopes. Additional site selection criteria include: habitats amenability to sampling, accessibility and safety (particularly from dangerous animals) (Kleynhans, 2007).

Riparian Assessment

The impacts on the aquatic and surrounding habitats of each site were assessed using the Index of Habitat Integrity (IHI) assessment protocol used in South African monitoring and described by Kleynhans (1996). This index is specific to South African ecosystems, but would still be able to identify the extent of impacts on the instream and riparian habitat and will thus be included in this study.

The index is based on a set of 12 weighted disturbances that are analysed for both the instream (IH) and riparian (RH) habitats separately. These disturbances represent some of the important and easily quantifiable anthropogenically induced impacts, including water abstraction; flow, bed and channel modification; inundation; exotic macrophytes; exotic aquatic fauna; solid waste disposal; indigenous vegetation removal; exotic vegetation encroachment and bank erosion. In order to calculate the respective impacts for the IH and RH habitats, each disturbance are assigned an impact rating and a confidence score, which will then be used to calculate an impact score using the formula: (impact rating/25) x (the weight of that impact). The estimated impacts of all criteria calculated in this way are then summed, expressed as a percentage and subtracted from 100 to obtain a habitat integrity value for the instream and riparian components, respectively.

9.1.5 Socio-economic

The objective of this specialist study is to characterise the existing socio-economic conditions of the Project Area, thus providing the initial setting to predict change during project construction and operation, as well as determining the affected population's sensitivity to disturbance, and ability to withstand any such disturbance. This will enable the identification and assessment of potential impacts arising from the Project and the establishment of measures to mitigate potential negative impacts and to enhance the potential positive impacts.

Secondary data will be validated and substantiated by the undertaking of socio-economic surveys in the Project Area. Field surveys will include verification of rural communities, households, relevant socio-economic landmarks and household interviews.

The objectives of the Social Impact Assessment can be summarised as follows:

- To define the area affected by the Project and people associated with these areas;

- To provide a detailed description of the people living and working in the project affected area, including all demographic information;
- To describe all economic and livelihood activities in the project affected area;
- To thoroughly describe the specific land ownership structures and land uses, including a description of all land users e.g. residential, farming, renters, farm workers;
- To count the number of directly affected households living and/or working (formally and informally) in the directly affected Project Area. The directly affected people will be recorded by name and location. They will form part of a stakeholder database that will be made available to the client;
- To open and maintain a database of households/ individuals that will be directly affected by the Project, this record will include how they will be affected by the Project;
- To describe the status of education, including levels of education, skills, literacy, and type, quantity and quality of education facilities;
- To describe the status of health, including common diseases, causes of diseases, and type, quantity and quality of health care facilities;
- To provide an overview of all infrastructure in the Project Area;
- To identify social and economic impacts that will result from the Project; and
- To propose appropriate mitigation measures for addressing the impacts identified.

A methodological process will be defined that is rigorous, defendable and appropriate to the local context, objectives of the study and target audience (eg a combination of household surveys and focus groups). The sampling method to be used to select respondents will be outlined and appropriate survey tools prepared.

9.1.6 Archaeology, Cultural and Heritage

The archaeological specialist study will determine the presence (or otherwise) of sites of archaeological or cultural significance in the Project Area, in order to ensure that the Project will not result in the destruction of these sites.

Areas identified in the baseline assessment as having a cultural and/or heritage significance will be surveyed in order to identify and document the presence of structures or artefacts of archaeological interest, and areas of cultural significance.

Identified sites (if applicable) will be Global Positioning System (GPS) marked for later mapping. Lithic materials and/or other relevant materials will be collected in order to create a reference collection. Any collected materials will be registered, studied and described, with clear reference to respective collection unit and site. Collected archaeological remains from every collection unit will be separately processed, according to type of material (stone, bone, pottery, metal, etc.).

Each new location yielding artifacts will be carefully identified, and the site will be accurately plotted on a map. Sites will also be systematically photographed. Records will contain, at least, the following data:

- Descriptive memoir of sites and their immediate surroundings at environmental level;
- Technical design of sites limits and layout, photographic and cartographic records and GPS references. Photographic records will be organised by site and collecting unit (ie National Heritage and Conservation Commission); and
- Fieldwork (strategy, soil, site dispersion) will be cartographically described.

The photographic record will include an image database illustrating sediments, soils, environmental niches and relevant features of the Project Area, thus building up a comprehensive archaeological database for the area.

A procedure for dealing with chance-finds during Project construction will be produced, as per the requirements of IFC Performance Standard 8.

9.2 THE STUDY TEAM

9.2.1 Details and Expertise of the Environmental Assessment Practitioners

Environmental Resources Management

Environmental Resources Management Southern Africa (Pty) Ltd. (ERM) has been appointed by the Project Proponent to undertake the Environmental Scoping and Impact Assessment Study for the proposed Project.

ERM as a consulting firm, and more specifically the project team selected on this project, possesses all the relevant expertise and experience to undertake this ESIA.

ERM is a leading global provider of environmental, health and safety, risk, and social consulting services and is committed to providing a global service that is consistent, professional and of the highest quality. ERM has been involved in numerous projects in Africa over the past 30 years and in 2003 established a permanent presence in the region to meet the growing needs of our clients. ERM Southern Africa is one of the largest totally focused environmental consulting firms in the region. With over 120 dedicated staff involved in environmental and social projects throughout the continent, ERM offers clients effective solutions using experienced local and global expertise.

The ERM project team associated with the Mulungushi HPP is as follows (all CVs have been included as *Annex C*):

Brett Lawson (Project Director) is a Partner within ERM's Impact Assessment and Planning (IAP) team based in Cape Town, South Africa. Brett spent the first half of his working life in natural resources management and research with conservation and wildlife agencies in South Africa, Namibia and Botswana. There was then a transition into more holistic environmental management via the South African National Parks' Lake Areas in the Southern Cape and for several years as an environmental advisor for South Africa's electricity public utility, Eskom. In 1995 Brett started consulting in environmental management as one of the founders of Bohlweki Environmental, the first emergent environmental consultancy established in South Africa. He later started The Environmental Partnership which he relinquished in 2004 as a fully empowered environmental consultancy. Thereafter, he joined Ninham Shand's environmental discipline group, where he eventually became the director. Before the company merged into Aurecon, he served as the Environmental Business Unit manager for Africa and the Middle East. Although Brett has considerable multi-disciplinary experience across a range of developmental and environmental sciences in a variety of geographies, his particular expertise in the environmental implications of energy generation and transmission resulted in his joining ERM's Southern African team, with a primary focus on the Power Sector in Sub-Saharan Africa.

Zoe Daniel (Project Manager) is a Principal Consultant within ERM's Impact Assessment and Planning team based in Cape Town, South Africa. Since joining ERM in 2003, Zoe has managed a number of large complex Environmental and Social Impact Assessments (ESIA) for power and infrastructure developments in Uganda, Zambia, Angola, Mozambique and Namibia. Zoe is currently project managing the Muchinga Hydropower Project for the Lunsemfwa Hydro Power Company. She also recently completed a World Commission on Dams assessment of the Bujagali hydropower project in Uganda and is the Project Manager for the Baynes Hydropower Project on the Angola-Namibia border.
Zoe is familiar with the IFC Performance Standards and the World Bank Equator Principles.

Dean Alborough (Assistant Project Manager) is a Consultant within ERM based in Cape Town, South Africa. Dean has gained experience in oil and gas and renewables (with a focus on wind and solar energy) ESIAs with a key role in project management, coordinating and integrating specialist findings, checking compliance and standardization with assessment methodology, and reporting. Dean has completed numerous renewable (wind and solar) EIAs over the past few years. He has a good understanding of the full range of implications of upstream oil and gas and renewable energy projects on the environment. Dean has more than four years' experience in integrated environmental management, having worked on projects in the oil and gas, and renewable energy industries, and more than seven years' experience in Environmental Science. His work experience has included environmental impact assessments, environmental management plans, environmental auditing and risk assessments.

Jacob Chishiba (Zambian Environmental and Procedural Advisor and Public Participation specialist) is an environmental consultant based in Lusaka, and is included on the Zambian Environmental Management Agency's (ZEMA) list of environmental practitioners. He holds a master's degree in environmental management and policy from Lund University in Sweden, and has over 20 years' experience in environmental management. In particular, he has worked on many projects for the Lunsemfwa Hydro Power Company (LHPC), including environmental impact assessments for the *Construction of a Power House at Johnson Valve at Mulungushi Dam & a 2 Kilometre Power Transmission Lines*, the *Upgrading and installation of No. 4 Turbine Generator at Lunsemfwa Hydro Power Station* and the *Construction of a 3km long canal for hydro power generation* at Mulungushi Power Station.

Janet Mkhabela (Social specialist) assisted Dr. Mitulo Silengo on the Muchinga Project, and is therefore proposed for this project due to her familiarity of the Project Area. Janet is a Consultant with the Impact Assessment and Planning (IAP) team based in the Cape Town office. She has five years' experience in the field of stakeholder consultation, social impact assessments and research. She has working mainly in the oil and gas, renewable energy (wind and solar) transport sectors (passenger trains, airports and freight rail). Janet has managed and coordinated numerous stakeholder engagement processes. She has also been involved in designing and implementing stakeholder engagement processes related to large infrastructure developments and oil and gas projects. In addition, she has completed numerous high level desk-based researches and deskbased social impacts assessments.

Warren McCleland (Flora and Fauna specialist) is a sub-consultant to ERM. He has 15 years' experience in conducting baseline surveys, data analysis and report writing in various biomes in southern and tropical Africa, particularly savannah, forest and grassland biomes. Warren has a specialist knowledge of identification of plants, mammals, birds, reptiles and frogs. He has experience in reporting according to IFC Performance Standards for numerous international projects in Sierra Leone, Guinea, Democratic Republic of Congo, Tanzania, Malawi, Mali, Mozambique and Zambia.

Robin Clanahan (Engineering and Environmental Interface and Advisor). has 51 years' experience in Water Resource and Hydropower development, management of consultants for all branches of civil engineering as well biophysical and sociological environmental specialists and financial experts. Specific experience includes water resources management, design and project management of dams, dam safety, canals and control structures, hydraulic modelling; hydropower and pumped storage; flood investigations and hydrology; environmental flow requirements; tunnels and underground works; rock mechanics; bulk water supply and reticulation; water treatment; pumping installations, pipelines and reservoirs; urban reticulation; borehole and wellfield development; housing and infrastructure, environmental impact assessment, resettlement and compensation.

Kurt Barichievy (Soils specialist) has been undertaking specialist soil assessments since 2007 and has gained experience throughout South Africa. Kurt has extensive knowledge in soil classification, sampling and mapping. Kurt also has experience in more specialised soil related activities such land use capability assessments, land use planning, soil impact assessments, soil erosion management plans and agricultural potential investigations. These skills have been applied in a variety of projects including power line and electrical infrastructure, mining applications, industrial facilities, housing and tourism developments, Environmental Management Frameworks and renewable energy facilities.

Michiel Jonker (Freshwater Ecologist) is a partner at Ecotone Freshwater Consultants CC since 2008. Michiel has been involved in a number flow related ecological assessments both nationally and abroad. These assessments ranged from proposed alteration in channel morphology, water quality and hydrology and mainly aimed at relating risks to aquatic responders such as diatoms, marcoinvertebrates and fish. Flow related projects include pipeline, power line, road, railway, silt and litter trap, treated waste water discharge and dam projects. Project localities include South Africa, Mozambique, Tanzania and Congo.

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10 CONCLUSION

It is evident that with increasing electricity demands in the Southern African Development Community (SADC) in general and in Zambia specifically, coupled with current regional and local energy supply deficits, that there is a need for investment in energy generation in this Region.

Investment in energy is a prerequisite to achieving commercial and industrial development in Zambia. If Zambia is to achieve those targets and goals stated in its Vision 2030, and detailed in the SNDP, the country will require private sector investment in energy technology that is efficient, sustainable and reliable. The generation of energy through hydropower is a proven technology that is sustainable and which is actively being promoted at a national level in Zambia. With a hydropower energy potential of approximately 6,000MW, hydropower is considered the most feasible and reasonable energy generation option for Zambia. It is for this reason that the Zambian government have shown an interest for such development.

In the light of this scenario, Lunsemfwa Hydro Power Company Limited, which Agua Imara AS has a 51 percent stake in, is considering developing a 80-100MW hydropower project (HPP) on the Mulungushi River in the Chibombo and Kapiri Mposhi Districts, located in the Central Province of Zambia. The Mulungushi HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station that will replace the existing but outdated ~30MW Mulungushi hydropower station.

As part of the Mulungushi HPP, LHPC are required to obtain environmental authorisation prior to construction of the Mulungushi HPP. As such, ERM have been appointed as the independent Environmental Assessment Practitioners to facilitate the environmental approval process in accordance with Zambia's Environmental Management Act (EMA) (Act 12 of 2011). Collaboration with a Zambian environmental management consultant, Jacob Chishiba, is being achieved by his involvement in the public participation process and providing a review and procedural guidance role on the ESIA reporting.

The environmental scoping study (this report – otherwise known as the Terms of Reference for the ESIA study) is the first phase of the overall ESIA process being undertaken for the proposed Mulungushi HPP. The purpose of the scoping study was to identify the potential environmental and socio-economic impacts resulting from the Project, based on a review of available data (baseline) and from the issues and concerns of stakeholders, raised during a series of pre-scoping stakeholder meetings in February 2013 which are described in the Issues and Concerns Log (*Annex B4*).

As discussed in *Chapter 7*, it is anticipated that the following key environmental and social aspects will be impacted by the Project:

- Soils;
- Terrestrial Flora and Fauna;
- Environmental flows and Aquatic ecology;
- Socio-economic impacts; and
- Cultural heritage.

Based on the initial assessment of the potentially significant issues, it is concluded that there are no environmental fatal flaws which would prevent the development of this Project. However, the impacts presented in this report will be further investigated and assessed within the ESIA phase. For this purpose, Terms of References for each specialist investigation identified and required for the ESIA, have been drafted.

The ESIA will suitably identify, investigate and address all environmental and socio-economic impacts in order to provide stakeholders with information on the impacts (both positive and negative) resulting from the Project, and to provide the authorities with sufficient information, so as to make an informed decision regarding approval of the Project.

Annex A

Terms of Reference

TERMS OF REFERENCE

For The Proposed Mulungushi Hydropower Project, Zambia

April 2013

1. INTRODUCTION

The Lunsemfwa Hydro Power Company Limited (LHPC), of which Agua Imara AS (formerly SN Power Africa) has a 51% stake in, is considering developing a 80-100MW hydropower project (HPP) on the Mulungushi River in the Chimuka and Kapiri Mposhi Districts, located in the Central Province of Zambia, approximately 60km to the south east of Kabwe. The Mulungushi HPP will consist of the development, financing, construction, operation, management and maintenance of a new electricity generation hydropower station that will replace the existing but outdated ~30MW Mulungushi hydropower station. The existing Mulungushi Dam will provide the reservoir of water required for the updated Mulungushi HPP, i.e. no new impoundment is necessary.

2. REGULATORY REQUIREMENT

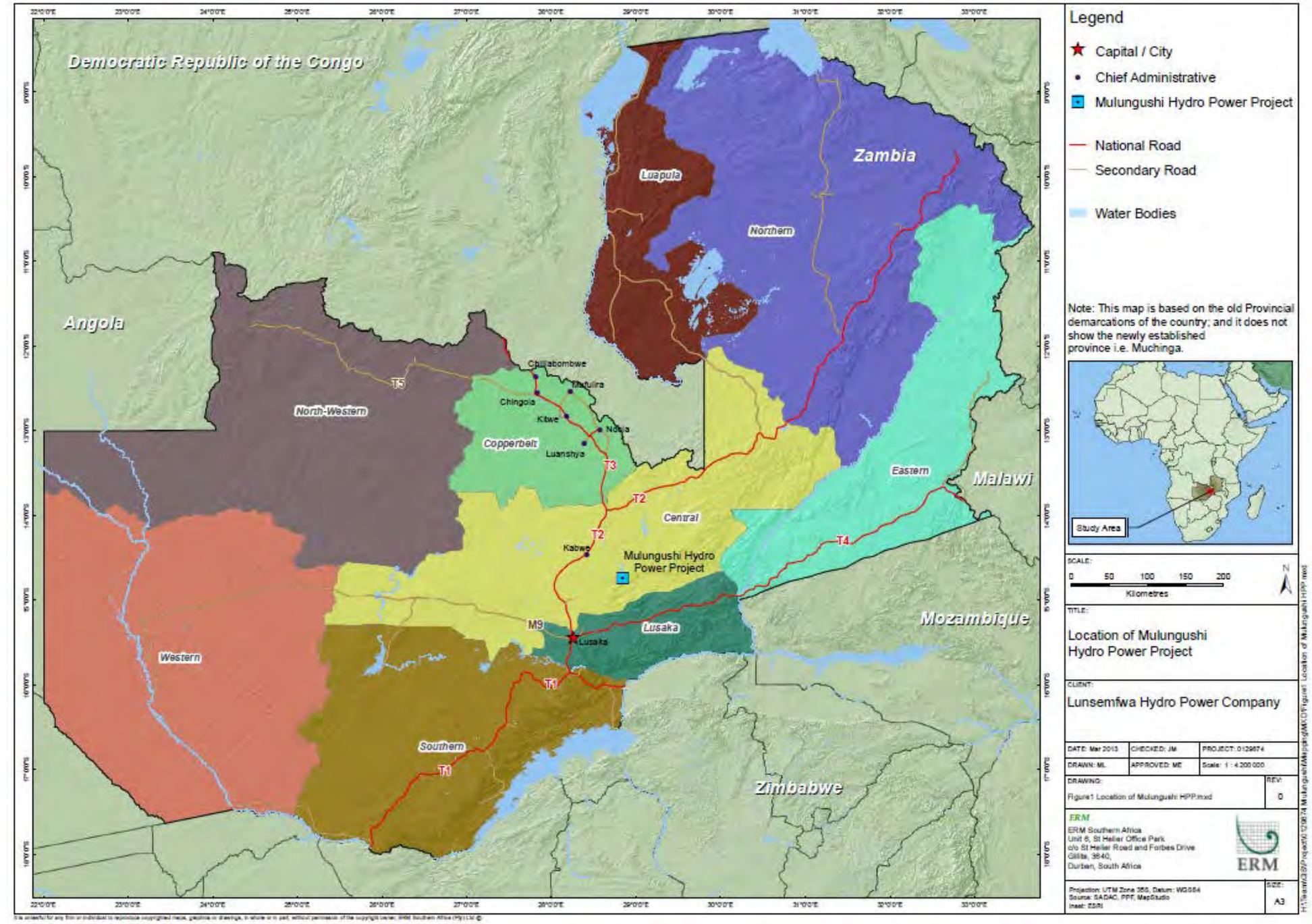
Elements of the Project constitute scheduled activities in terms of the Environmental Protection and Pollution Control Act (No. 12 of 1990). As such, an Environmental and Social Impact Assessment (ESIA) is required. In addition to Zambian legal requirements, the ESIA will also need to conform to international standards and good practices, in particular the requirements of the World Bank Group, International Finance Corporation (IFC) and the Equator Principles. The ESIA will also conform with other international guidelines and standards directly applicable to hydropower projects such as the World Commission on Dams (WCD) and the International Hydropower Association (IHA).

3. PROJECT DESCRIPTION

The proposed Mulungushi HPP is located in the Central Province of Zambia, approximately 60km to the south east of Kabwe (*Figure 1*). The Mulungushi HPP, situated in the greater Lunsemfwa Catchment, will be constructed adjacent to the existing Mulungushi Powerhouse, and fed by a 5.4km pressure tunnel directly from the Mulungushi Dam (Alternative 1).

The Project is located within the chiefdom areas of Chimuka, Mukonchi and Chembe. These areas are presided over by chiefs who exercise control over the land tenure of these customary lands.

Figure 1 *Location of the Mulungushi Hydro Power Project*



The Mulungushi HPP (Alternative 1) was selected from one of four alternatives that were evaluated in terms of their net benefit (input costs relative to their power generation capacity).

Construction of the Mulungushi HPP will involve the construction of a pressure tunnel (approximately 5.4km in length) from the Mulungushi Dam directly to the new Mulungushi Powerhouse which will be built adjacent to the existing Mulungushi Powerhouse (approximately 400m downstream). Water from the Mulungushi Dam will be fed into the pressure tunnel through a power intake that connects the upper end of the pressure tunnel to the Mulungushi Dam. The pressure tunnel drops approximately 400m in elevation from the power intake at the Mulungushi Dam down to the new Mulungushi Powerhouse.

The new Mulungushi Powerhouse is planned to be a surface facility instead of being constructed underground, and will contain two 40-50MW Francis turbines, located on the left bank of the Mulungushi River between the existing powerhouse and it's confluence with the Katobo River. The Francis turbines have a slighter higher efficiency than the considered alternative, and will, due to the fact that they operate submerged, also utilize a slighter higher head than Pelton turbines.

The Mulungushi HPP will have a higher installed capacity than the existing Mulungushi Hydropower Station, in order to utilize all the water available. For the Mulungushi HHP, a future average annual extraction capacity of about $20m^3/s$ has been estimated. Such flow would lead to a more or less complete dam drawdown in the driest years, with the average spillage estimated to be almost negligible (~1 percent).

The total installed capacity of the Mulungushi HPP will be in excess of the capacity of the existing 66kV line to the ZESCO sub-station at "14-Miles". Instead of strengthening the line capacity, the Mulungushi HPP will be connected to the new 330kV transmission line from the Muchinga HPP (located to the east of the Mulugushi HPP) to the "14-Miles" sub-station. This transmission line is planned to pass by Mulungushi along the same route as the existing 66kV line.

A new access road of approximately 4.5km is planned which will link the village of Mulungushi to the new Mulungushi Powerhouse at the bottom of the gorge. An initial road routing, parts of which will be in steep terrain, has been determined.

4. PROJECT MOTIVATION

Investment in energy is a prerequisite to achieving commercial and industrial development in Zambia. The use of solar power is favourable in providing rural areas with access to power; however, if Zambia is to achieve those

targets and goals detailed in its Vision 2030 and other complimentary plans, the country will require private sector investment in base-load energy technology that is efficient, sustainable and reliable. The generation of energy through hydropower is a proven technology that is sustainable and which is actively being promoted at a national level in Zambia. With a hydropower energy potential of approximately 6,000MW, hydropower is considered the most feasible and reasonable electrification option for Zambia.

5. SCOPE OF WORK

Consideration of the receiving environment is a prerequisite for the identification of potential environmental and socio-economic impacts. As such, it is important to gain an understanding of the biophysical and socio-economic baseline attributes of the Project Area and surrounds, as this will allow for a better understanding of the environment in which the project is being considered. These attributes comprise the following:

- Climate
- Air Quality
- Geology
- Soils
- Topography
- Hydrology
- Fauna (Aquatic and Terrestrial)
- Flora (Aquatic and Terrestrial)
- Socio-economic
- Cultural and Heritage

The biophysical and socio-economic baseline studies will be done in the following two phases:

1. A desktop study of all existing information on the biophysical and socio-economic environment; and
2. Site assessments and primary data collection.

6. PUBLIC CONSULTATION

The stakeholder engagement process has been carried out in accordance with the Zambian Environmental Management Act (Act No. 12 of 2011); Environmental Impact Assessment (EIA) Regulations (Statutory Instrument No. 28 of 1997); the World Bank Group Requirements and Guidelines for Public Consultation; and the World Commission on Dams (WCD) – Strategic Priority One.

A number of methods will be used to notify national, regional and local stakeholders. These methods of notification include:

- Submission of formal letters of invitation to key stakeholders.
- Preparation and submission of a Background Information Document prepared in English and Bemba to key stakeholders.
- Publication of adverts in a national newspaper – *Times of Zambia*.
- Placement of a number of site notices.
- Setting up of a Project website for stakeholders to access.
- Meetings with National, Regional and Local Authorities, Chiefs and Key Government Institutions.
- Chiefdom and Chiefdom Community meetings.

7. KEY ENVIRONMENTAL AND SOCIAL ASPECTS

It is anticipated that the following key environmental and social aspects may be impacted by the proposed Project:

- Soils;
- Terrestrial and aquatic flora;
- Terrestrial fauna;
- Environmental flows and associated impacts to downstream aquatic ecology;
- Water quality downstream;
- Socio-economic impacts; and
- Cultural heritage.

These aspects will be further investigated and assessed within the ESIA phase through specialist studies. The ESIA will suitably identify, investigate and address all biophysical and socio-economic issues in order to provide the authorities with sufficient information to make an informed decision regarding the Project.

8. CONCLUSION

The environmental scoping study is the first phase of the overall ESIA process being undertaken for the proposed Mulungushi HPP. The purpose of the scoping study is to identify the potential environmental and social impacts resulting from the Project, based on a review of available data (baseline) and from the issues and concerns of Interested and Affected Parties (I&APs). Based on the initial assessment of the potentially significant issues, the preliminary indications are that an acceptable level of environmental impact may be achieved as a consequence of the Project. However, the impacts presented in this report will be further investigated and assessed within the ESIA phase.

The ESIA will comprehensively consider all the biophysical and socio-economic impacts, thus providing stakeholders with information on the impacts (both positive and negative) resulting from the Project, and to provide

the authorities with sufficient information, so as to make an informed decision regarding approval of the Project.

Annex B

Consultation Materials

Annex B1: Background Information Document (BID);

Annex B2: Consultation Schedule;

Annex B3: Development Presentation (given at community meetings);

Annex B4: Issues and Concerns Log;

Annex B5: Proof of Consultation: Photolog and Attendance Registers from Authority and Community Consultations;

Annex B6: Proof of Advertisements; and

Annex B7: Proof of Site Notices.

Annex B8: Meeting Minute Template

B1 BACKGROUND INFORMATION DOCUMENT (BID)

The BID will be distributed to Interested and Affected Parties (I&APs) prior to engagement, and to a number of days specified by relevant legislation.

B2 CONSULTATION SCHEDULE

The consultation schedule will be communicated to the relevant authorities (including chiefs and headman) in advance, and to a number of days specified in the relevant legislation.

B3 DEVELOPMENT PRESENTATION (GIVEN AT COMMUNITY MEETINGS)

The development presentation will be compiled by ERM, and reviewed by relevant parties, prior to stakeholder engagement at community meetings.

The full issues and concerns log will be developed during stakeholder engagement, and included in the ESIA Report. The comments and issues raised during the pre-scoping consultation phase which took place in February 2013 are outlined below.

Comments/Issues Raised in Focus Group Meetings (FGDs)

Consultation Type	Date	Village/ District	Stakeholder	Category of Issue(s)	Issue(s) or Comment(s)	Preliminary Response	Additional Notes
SIA: Consultation	13.02.2013	Kapiri Mposhi District	District Planner	Project Activities	What else is being planned as part of the project?	A service road will be constructed in order to transport goods and materials needed for the construction of the new station.	
SIA: Consultation	13.02.2013	Chibombo District	District Planner	Rural electrification	Will the project assist in fast tracking rural electrification?	Not sure	
SIA: Consultation	14.02.2013	Ntimpa Village	Headman	General	Any development in the area is welcomed as it might improve the quality of life for people in the area.	Noted.	
SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Women	General	Does your company (ERM) provide funding to CBOs such as the Women's Club? The Club is struggling as it has not received any funding from government since its inception.	It does provide some assistance to CBOs, but only in countries where we have offices	
SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Women	In-migration	Worried about the presence of outsiders in the area as there are no police services.	This will be assessed as part of the socio-economic impact assessment and mitigation will be provided to minimise the effects where possible	

SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Women	CSR	LHPC has not provided any assistance to orphaned children in the village as it has done for children in other villages.	We will make the necessary enquiries regarding this and get back to you.	An LHPC representative stated that it's the government that give hand-outs to orphaned children and not the LHPC. This often includes, school uniforms, food parcels, and blankets.
SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Women	Employment opportunities	LHPC doesn't employ women. Whatever work that men can do, women can also do.	Noted, we will make a recommendation to the LHPC to hire women, where possible.	An LHPC representative stated that the employment of women will have to be cleared with top management.
SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Women	Project Description	Need to know more information about the project and more people from the village need to be consulted.	This is not the public participation process, but the gathering of socioeconomic data for the social specialist study. Towards the end of march someone else will come to the area for public meetings and everyone will be invited.	

SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Men	Project Description	You say the project will affect us, how?	The proximity of the village to the road that is already used to access the Project site means that the villagers will be exposed to increased road traffic during the construction activities. Furthermore, narrow sections of the roads may need to be extended in order to accommodate heavy vehicles, and some structures close to these areas will have to be relocated. But no final detailed plans for the roads are available at present. The public will be informed of these once they are available.	
SIA: Consultation	15.02.2013	Ntimpa Village	FGD: Men	Resettlement	So there will be relocation?	There is a possibility, but of structures or crops which are too close to the sections of the road that will need widening. From what we have seen there are limited structures close to the road, and those that are close, are mostly small shops that can easily be moved to another spot along the road. Further details on the project will be presented at the public meetings. We will inform the headman of the meetings and he will invite all his people to the meeting.	

SIA: Consultation	16.02.2013	Nomsimbila, Mumbi, and Yelela Villages	FGD: Men	Resettlement	Will any structures located close to the road be relocated?	There is a possibility, but of structures or crops which are too close to the sections of the road that will need widening. From what we have seen there are limited structures close to the road, and those that are close, are mostly small shops that can easily be moved to another spot along the road. Further details on the project will be presented at the public meetings. We will inform the headman of the meetings and he will invite all his people to the meeting.	
SIA: Consultation	16.02.2013	Nomsimbila, Mumbi, and Yelela Villages	FGD: Men	Compensation for Resettlement	Will people affected by the resettlement be compensated?	Where necessary, yes. But our recommendation would be for LHPC to construct a new structure where one has been demolished and provide seeds and land where crops have been destroyed and compensation for the cropping season lost due to the project.	

SIA: Consultation	16.02.2013	Nomsimbila, Mumbi, and Yelela Villages	FGD: Women	Employment opportunities	Will women be given employment opportunities? In Lunsemfwa women were given minor jobs such as collecting rocks needed for construction.	We don't know yet, however, we will make a recommendation to the LHPC to hire women, where possible.	
SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	disruption of Crops	What will happen if our crops are affected by the proposed new road?	Should your crops be affected, we will recommend that compensation be paid for one cropping season and replacement land be provided. But it is unlikely that the project will affect any of the crops near your area as the road will be constructed on LHPC land.	
SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	Road construction	Some time ago, the LHPC constructed a road to the bottom of the gorge and did not inform the headman.	We cannot answer that, we will direct to the LHPC.	An LHPC representative stated that they have not constructed any roads before in the area, the headman might be talking about a road that was created by some mining company that was looking for gold years ago.
SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	Communication	The headman was not told of your visit in the area. Each time people come to our area they should consult the headman first, so that he can inform the Chief of your presence.	We had advised the LHPC to inform the Chief and relevant headman of our visit, should this have not happened we apologise and we will follow up with the LHPC.	An LHPC representative stated that all the relevant traditional authorities were informed of our visit prior to our arrival in the country.

SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	Treatment of headmen	LHPC doesn't respect all headmen in the area, and shows more respect to headman Ntimpa than other headmen.	Noted. We will inform the LHPC.	An LHPC representative said there was no truth to this, may this comment was brought on by the fact that headman Ntimpa is the only headman that works for the LHPC. ERM advised that the LHPC investigate and rectify accordingly.
SIA: Consultation	17.02.2013	Kasonde Village	FGD:Women	Compensation for the previous resettlement process	Not everyone who was resettled by the LHPC has received compensation.	Noted. We will inform the LHPC.	According to an LHPC representative the LHPC did not undertake the resettlement process. This was done by the ZCCM and he agreed that some people were not compensated because of the issues with the headman. ERM advised that LHPC should be in touch with ZCCM official and ask them to resolve any pending issues related to the previous resettlement before they spill over to this process.
SIA: Consultation	17.02.2013	Kasonde Village	FGD:Women	Road construction	Is the entire road going to be widened?	Not sure, but certain narrow sections might need to be widened to allow for heavy vehicles to pass each other safety. More details will be available at the public meetings.	

SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	Hunting in LHPC land	The land given to the LHPC as part of the resettlement is sitting there unused and all the wildlife is hidden in there. Can the LHPC allow the villages to go hunting there?	We will inform the LHPC of your request, but the resettlement was for health and safety purposes as people are not suppose to be close to the power station and its associated infrastructure.	
SIA: Consultation	17.02.2013	Kasonde Village	Headman and Men	LHPC property boundaries	The LHPC property boundaries are to close to some existing property and crops in the village.	Noted. We will inform the LHPC.	An LHPC representative stated that this resulted when the headman didn't want to move away from the cutline.
	13.02.2013 to17.02.2013	All villages	All meetings	Growing of crops along the dam	Can the LHPC allow women to grow crops along the dam for easy access to water?	Noted. We will inform the LHPC. However, this request might not be approved for health and safety reasons.	

B5 PROOF OF CONSULTATION: PHOTOLOG AND ATTENDANCE REGISTERS FROM AUTHORITY AND COMMUNITY CONSULTATIONS

B5.1 PHOTOLOG

A Photolog will be compiled during stakeholder engagement meetings for the scoping and ESIA consultation phases, and included in the ESIA Report.

B5.2 ATTENDANCE REGISTERS FROM AUTHORITY AND COMMUNITY CONSULTATIONS

Attendance Registers will be recorded for all stakeholder engagement meetings. The pre-scoping attendance registers are provided below.

Mulungushi SIA Consultation

Village Name:
Date:

ATTENDANCE REGISTER

Title, First name & Surname	Organisation Name	Position in Organisation	Telephone / Cellphone Numbers	Fax Number	Email Address	Postal Address
MRS Janet Zulu	Central Statistical Office	Regional Statistician	0976532267	05 222944	jncheka@yahoo.co.uk	Box 80110 Kabwe, Zambia
Jospine Mwanza	Chibombo District Council	Council Secretary	0979487040	05 274070	josphine-mwanza@yahoo.com	Box 50 Chibombo Zambia.

Mulungushi SIA Consultation

Village Name: Kapiri Mposhi District Officials) 13/02/13
Date:

ATTENDANCE REGISTER

Title, First name & Surname	Organisation Name	Position in Organisation	Telephone / Cellphone Numbers	Fax Number	Email Address	Postal Address
Janet Mkhabela	ERM S.A.	Consultant	+27216815400	—	janet.mkhabela@erm.com	—
CHANDA SENKWE	KAPIRI DISTRICT COUNCIL.	DISTRICT PLANNING OFFICER	0977-273096		senkwec@gmail.com	
SIYUMBANO TERRY	CHIBOMBO DISTRICT COUNCIL	Ag Director of Works	0977-944857	~~025~~ ~~0540~~ 05-274070	Kerrysiyu@yahoo.com	CDC SO Chibombo

Mulungushi SIA Consultation

Village Name: LHP
Date: 14/02/13 Mulungushi Clinic

ATTENDANCE REGISTER

Title, First name & Surname	Organisation Name	Position in Organisation	Telephone / Cellphone Numbers	Fax Number	Email Address	Postal Address
2EM/2EM CHRISTINE SIYUNDA	MULUNGUSHI COMMUNITY POWER STATION RHC	IN-CHARGE	097945 22 42			
CASHIER/RECORDS CLERK NATHAN MUSAMBA	MULUNGUSHI COMMUNITY P/S RHC		0979579390			
MWIYA MWENDENDE	MULUNGUSHI POWER STATION COMMUNITY	EHT	~~0026097778969H~~ 0977896944		Mwiya1010@yahoo.com.	
KAWENE CHARLES	MULUNGUSHI POWER STATION PRIMARY /ALTERNATIVE SEC SCHOOL	HEAD TEACHER	0977891806		Charleskawene@gmail.com	Box 80237, KABWE

Mulungushi SIA Consultation

Village Name:
Date:

ATTENDANCE REGISTER

Title, First name & Surname	Organisation Name	Position in Organisation	Telephone / Cellphone Numbers	Fax Number	Email Address	Postal Address
ANDREW NTIMPA	Chief Chamuka Chiefdom.	SENIOR HEADMAN	0979756566			
MUMBI	CHIEFDOM CHAMUKA	HEADMAN	0974123984			
NANSAMBILA	CHIEFDOM CHAMUKA	HEADWOMAN	0971732558			
HELELA	CHIEFDOM CHAMUKA	HEADMAN	REP Mumbi			
KASONDE	MWICHUCH	HEADMAN	0976382181			

B6 PROOF OF ADVERTISEMENTS

The newspaper advertisements published in accordance with relevant legislation will be included in the ESIA Report.

B7 PROOF OF SITE NOTICES

The site notices required by relevant legislation will be included in an annex to the final ESIA report.

B8 MEETING MINUTES TEMPLATE

The meeting minute's template which will be used during future consultations with stakeholders is provided below.

Meeting minutes

Environmental Resources Management

ERM Southern Africa
2nd Floor
The Great Westerford
240 Main Road
Rondebosch
Cape Town 7725

T: +27 21 681 5400
F: +27 21 686 0736
http://www.erm.com

Subject/Ref	
Venue	
Date of Meeting	
Present	
Distribution	
Date	19 March 2013

	ACTION

Annex C

Curriculum Vitae

Brett Lawson

Partner
Impact Assessment and Planning

Brett Lawson is a Partner within ERM's Impact Assessment and Planning (IAP) team based in Cape Town, South Africa.

Brett spent the first half of his working life in natural resources management and research with conservation and wildlife agencies in South Africa, Namibia and Botswana. There was then a transition into more holistic environmental management via the South African National Parks' Lake Areas in the Southern Cape and for several years as an environmental advisor for South Africa's electricity public utility, Eskom.

In 1995 Brett started consulting in environmental management as one of the founders of Bohlweki Environmental, the first emergent environmental consultancy established in South Africa. He later started The Environmental Partnership which he relinquished in 2004 as a fully empowered environmental consultancy. Thereafter, he joined Ninham Shand's environmental discipline group, where he eventually became the director. Before the company merged into Aurecon, he served as the Environmental Business Unit manager for Africa and the Middle East.

Although Brett has considerable multi-disciplinary experience across a range of developmental and environmental sciences in a variety of geographies, his particular expertise in the environmental implications of energy generation and transmission resulted in his joining ERM's Southern African team, with a primary focus on the Power Sector in Sub-Saharan Africa.

Fields of Competence

- Environmental Impact Assessment and Management Plans
- Environmental/Sustainability Planning and Analysis
- Environmental Management Systems and Auditing
- Review and Due Diligence in environmental management
- Strategic Environmental Assessment

Professional Affiliations & Registrations

- Registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (*PrSciNat* Reg No 400106/04)
- Certified as an Environmental Assessment Practitioner with Environmental Assessment Practitioners of South Africa (EAPSA)
- Member of the International Association for Impact Assessment South African Affiliate (IAIAsa)
- Member of the Game Rangers Association of Africa (GRAA)

Education

- MA (Environmental and Geographical Science), University of Cape Town, 1996
- Diploma (Small Business Management), Potchefstroom University, 1989
- BA (Geography), University of South Africa, 1985
- Diploma (Nature Conservation and Wildlife Management), Pretoria Technikon, 1976

Languages

- English
- Afrikaans

Key Industry Sectors

- Energy
- Mining
- Transportation
- Civil infrastructure
- Natural resources

Honours and Awards

- Past President of IAIAsa (2006/2007)
- Study tour to Florida, USA: presented paper at Electric Power Research Institute conference and undertook research at electricity utilities

Publications

- Lawson, A B 1997. Applying Sector-specific EIA Methods: Lessons Learnt from Large Linear Developments. Proceedings of the annual conference of the South African chapter of the International Association for Impact Assessment, KwaMaritane, September, 1997.
- Lawson, A B 1996. Environmental Impact Assessment in the Routing of High Voltage Overhead Transmission Lines: Theory and Practice in South Africa. Unpublished MA Dissertation. University of Cape Town, 1996.
- Lawson, A B 1995. Environmental Impact Assessment within the Power Utility Industry in South Africa: the Distribution Group Perspective. Proceedings of the 15th annual International Association for Impact Assessment conference, Durban, June 1995.
- Lawson, A B 1993. Monitoring Wildlife and Powerline Interactions in the Fynbos Biome. In Monitoring Requirements for Fynbos Management, Marais, C & Richardson, D M (eds), Programme Report Series No. 11, FRD. (Short communication)
- Lawson, A B & Wyndham, M J 1992. A System of Monitoring Wildlife Interactions with Electricity Distribution Installations in a Supply Region of the Cape Province in Southern Africa. Proceedings of the EPRI International Workshop on Avian Interactions with Utility Structures, Miami, Sept. 1992.
- Earle, R A & Lawson, A B 1988. An Annotated Check List of the Birds of the Golden Gate Highlands National Park. Koedoe 31: 227-243.
- Norton, P M, Lawson, A B, Henley, S R & Avery, G 1986. Prey of leopards in four mountain areas of the south-western Cape Province. S Afr J Wildl Res 16: 47-52.
- Norton, P M & Lawson, A B 1985. Radio tracking of leopards and caracals in the Stellenbosch area, Cape Province. S Afr J Wildl Res 15: 17-24.
- Lawson, A B 1982. Notes on the mammals of the Gamka Mountain Reserve, Cape Province. Bontebok 2: 1-8.

Key Projects

Regulatory Processes and Environmental Impact Assessment

Retail Centres, Luanda, Lobito, Huamba, Belas, Lubango and Palanca, Angola, Shoprite, 2012
Project Director
Directed the Environmental Impact Assessment (EIA) processes for Shoprite's new retail facilities in several centres in Angola.

Kriel Power Station, new ash dump, Mpumalanga Province, South Africa, Eskom, 2012
Project Director
Directed the EIA process for Eskom's new ash disposal facility at the Kriel Power Station

Proposed Wind Farms, Eastern and Western Cape, South Africa, iNca Energy, 2012
Project Director
Directed three EIA processes for iNca Energy's wind farms in the Komsberg, Gouda and Vredenburg areas.

Hydropower Plant, Northern Cape, South Africa, Mulilo Renewable Energy, 2012
Project Director
Directed the EIA process for a 7 MW run of river hydropower plant on the Orange River near Kakamas in the Northern Cape.

Proposed Khanyisa Power Station, Witbank, Mpumalanga Province, South Africa, Anglo American, 2011
Review consultant for the EIA for a coal discard power station proposed by Anglo Coal near Witbank.

Proposed Solar Farm, Aurora, Western Cape, South Africa, Solaire Direct, 2011
Project Director
Directed the EIA process for Solaire Direct's proposed PV solar farm near Aurora on the West Coast.

Moatize Coal Mine Expansion, Tete Province, Mozambique, Vale, 2010
Project Manager
Managed the EIA process for the expansion of Vale's existing coal mine in northern Mozambique. This formed part of a larger project that included a railway line to the coast at Nacala and relied heavily on a number of specialists and detailed technical input.

Floating LNG EIA and EMP, Western Cape, South Africa, PetroSA, 2012
Project Director
Directed an EIA process for the development of a facility to transfer LNG from an LNG vessel to shore, to bolster feedstock supply to PetroSA's gas-to-liquid facility at Mossel Bay.

Tutuka Power Station brine and groundwater infrastructure EIA, Mpumalanga, South Africa, Eskom, 2010
Project Director
Directed the EIA process for Eskom, to reduce its operational environmental impacts at the Tutuka Power Station, through the establishment of a brine concentration plant and a groundwater abstraction plant.

Waterberg Coal Fired Power Station, Limpopo, South Africa, Eskom, 2009
Project Director
Directed an EIA for the construction of a new coal fired power station in the Waterberg area, for Eskom. This large scale project is currently dormant but included extensive public participation and a suite of specialist studies.

Environmental and Socio-Economic Impact Assessment for proposed NamPower coal-fired power station at Walvis Bay, Namibia, NamPower, 2008
Project Director
Directed an Environmental & Socio-Economic Impact Assessment (ESEIA) for a proposed coal-fired power station at Walvis Bay, for NamPower. The appointment included a site screening and selection process, scoping study and ESEIA, supported by an Environmental Management Plan (EMP)
.

Rössing Uranium Mine expansion project, Erongo Region, Namibia, Rio Tinot, 2008
Project Director
Directed a comprehensive and multi-disciplinary EIA process for Rio Tinto's Rössing Uranium mine expansion project

Coal-fired Power Station and Associated Infrastructure in the Witbank Area (Kusile), Mpumalanga, South Africa, Eskom, 2006
Project Manager
Managed the comprehensive and multi-disciplinary EIA process for a new 5 400 MW base-load power plant.

Open Cycle Gas Turbine power plant, fuel supply pipeline, substation and transmission lines, Mossel Bay, Western Cape, South Africa, Eskom, 2005
Project Manager
Managed the comprehensive and multi-disciplinary EIA process for a new peaking generation power plant and associated infrastructure.

Gurue – Lichinga 110 kV powerline, Mozambique, NorConsult, 1999
Powerline EIA specialist
Commissioned by a Scandinavian development agency (NorConsult) to undertake an EIA for a new electricity distribution network in northern Mozambique.

Environmental Management Plans

Berg River Dam Project, Western Cape, South Africa, 2005
Locum for Environmental Monitor for Berg River Consultants responsible for the performance monitoring of the application of the EMP for a significant dam construction project.

Chapmans Peak Drive road rehabilitation, Western Cape, South Africa, Provincial Government, 2004
Project Manager appointed by the Provincial Government to apply the EMP and manage an environmental monitoring committee.

Institutional and Policy Development and Professional Review Services

Independent review of EIA for golf course development, Plettenberg Bay, Western Cape, South Africa, Department of Environmental Affairs and Development Planning. 2006
Project Manager
Appointed by the Department of Environmental Affairs and Development Planning to undertake the independent review of the EIA documentation and process for Roodefontein golf course/ residential development.

Independent review of EIA/EMP for Chapmans Peak Drive road rehabilitation, Cape Town, Western Cape, South Africa Provincial Government, 2004
Appointed as a consulting team member by the Provincial Government to provide an independent review and advisory service for the planning, approval and construction of road rehabilitation.

Independent review of powerline EIA, Northern Cape, South Africa, Eskom, 2002
Project Manager
Managed an independent review of Eskom's Oasis - Kanoneiland 66 kV powerline EIA process and documentation.

Assessment of Water Resource Developments and Catchment Management

Port of Durban Master Plan, Durban, KwaZulu Natal, South Africa, National Ports Authority, 2002
Appointed as a specialist by the National Ports Authority to undertake the environmental component of a Master Plan formulation for the Port of Durban.
.
Liesbeek River canal rehabilitation, Cape Town, Western Cape, South Africa, City of Cape Town, 2002
Project Manager
Managed an EIA for the rehabilitation of the Liesbeek River canal.

Specialist Facilitation, Public Processes, Training and Social Surveys

Kalk Bay heritage assessment, Kalk Bay, Western Cape, South Africa, 2002
Appointed by a private developer to undertake the public participation process for the redevelopment of New Kings and Majestic historic sites.

Krantzkop SEA, Wellington, Western Cape, South Africa, Somchem, 1998
Appointed by Somchem to undertake the public participation process for an SEA for the possible redevelopment of an explosives manufacturing plant.

Zoe Daniel

Principal Consultant
Impact Assessment and Planning (IAP)

Zoe is a Principal Consultant with ERM Southern Africa's Impact Assessment and Planning (IAP) team based in Cape Town.

Over the past 9 years, Zoe has managed a wide portfolio of high profile and large-scale projects in a range of industry sectors including oil and gas and power sector in Africa.

Zoe is an experienced project manager and has gained considerable experience in carrying out Environmental and Social Impact Assessments (ESIA) that meet international environmental and social assessment standards (including those of the International Finance Corporation (IFC), and others).

She is currently project managing an ESIA for a 3D seismic survey in Uganda. Other recent oil and gas experience includes:

- ESIA for 2D on-shore seismic oil and gas exploration survey activities, Kosmos Energy Cameroon HC, Cameroon
- ESIA for an Early Production System, Tullow Uganda Operations Pty Ltd, Uganda
- ESIA for exploration drilling, Kosmos Energy Cameroon HC, Cameroon
- Environmental and Social Impact Assessment (ESIA) for the Proposed Muchinga Hydropower Project on the Lunsemfwa Lower/Mkushi, Muchinga Power Company (MPC), Zambia
- ESIA for the Baynes Hydropower Project on the Kunene River on the Namibian/Angola border
- World Commission on Dams (WCD) Compliance Assessment of Bujagali Hyropower Power Project, Bujagali Energy Limited, Uganda

Fields of Competence

- Project Management
- Environmental and Social Impact Assessment (ESIA)
- Public Consultation and Disclosure

Professional Affiliations & Registrations

- Government of Uganda, National Environmental Management Authority (NEMA) registered EIA Practioner, 2008 - 2009, <*currently applying for 2012*>

Education

- MSc (Environmental Assessment and Evaluation), London School of Economics and Political Science, United Kingdom, 1998
- BA (Political Economy of Industrial Societies and French Minor), University of California Berkeley, USA, 1996
- The School for Field Studies, Sustainable Tourism Development, Island and Tropical Resource Management, Palau, 1995

Languages

- English
- French (working knowledge)

Key Industry Sectors

- Oil & Gas
- Power

Key Projects

Environmental and Social Impact Assessments

Environmental Baseline Study (EBS) and Environmental and Social Impact Assessment (ESIA) for a 3D Seismic Survey for the Jobi Rii and Jobi East and Mpyo BBegeri Suuvey Areas, Tullow Uganda Limited and Total Exploration and Production Uganda, Uganda, 2011 – current.
ERM was commissioned to conduct an Environmental Impact Assessment for the Jobi Rii and Jobi East field and the Mpyo Bbegeri field in preparation for the planned 3D seismic acquisition located in Murchison Falls National Park. The EIA process was conducted in accordance to Ugandan EIA Regulations, the World Bank Safeguard Policies and the IFC performance standards. Responsibilities include client liaison, integration and report writing of EIA report and EMP, coordinating specialist team and public participation, and financial management.

Environmental and Social Impact Assessment (ESIA) for the Proposed Muchinga Hydropower Project on the Lunsemfwa Lower/Mkushi, Muchinga Power Company (MPC), Zambia, 2011 – current.
ERM and African Mining Consultants (AMC) were appointed to undertake an ESIA for the proposed Muchinga Hydropower Project. The ESIA process was conducted in accordance to the Zambian EIA Regulations, the World Bank Safeguard Policies and the IFC performance standards and in conformance with the World Commission on Dams (WCS) and the International Hydropower Association (IHA) guidelines. Responsibilities include client liaison, integration and report writing of ESIA report and ESMMP, coordinating specialist team and public participation, and financial management.

Ndian River Block On-land Exploration Drilling ESIA, Kosmos Energy Cameroon HC, Cameroon, 2010 – 2011.
Kosmos Energy Cameroon HC is the operator of the Ndian River Block located onshore in the northern part of the Rio Del Rey sedimentary basin in the Republic of Cameroon. Following the 2D seismic ESIA carried out in 2009, Kosmos is currently planning exploration drilling of two wells. ERM was commissioned to undertake an Environmental and Social Impact Assessment (ESIA) and the associated Environmental Management Plan (EMP) in preparation for the planned exploration drilling in early 2012. Responsibilities included client liaison, integrative writing, financial management and coordinating specialist team.

Exploration drilling ESIA for offshore Safola and M-10 Blocks, Sasol, Mozambique, 2010 – 2011.
ERM has been appointed by Sasol to undertake and Environmental and Social Impact Assessment (ESIA) for exploration well drilling in the Sofala and M-10 blocks. The ESIA was comprised of three phases, namely a Scoping Study Phase, a Specialist Study Phase and Integration and Assessment Phase. The final report included a comprehensive Environmental Management Plan (EMP). As project manager, responsibilites, included included client liaison, integrative writing, financial management and coordinating specialist team.

ESHIA for Baynes Hydropower Project, Angola and Namibia, 2008 – current.
ERM has been appointed to conduct an Environmental, Social and Health Impact Assessment (ESHIA) for the proposed Baynes Hydropower Project on the Kunene River. The ESHIA process consists of two phases: Phase 1 – Scoping; and Phase 2 – Baseline, Impact Assessment and Framework Environmental and Social Management Plan (ESMP). The ESHIA process is being conducted in accordance to the Angolan EIA Regulations, the Namibian EIA Regulations, the World Bank Safeguard Policies and the IFC Performance Standards. Responsibilities include management and administration of the project, integrative writing of the ESHIA and coordinating specialist teams.

West Africa Cable System (WACS) Permits in Principle (Group 1 and Group 2 Countries), Angola, 2009-2011.
WACS is a proposed fibre optic submarine cable that would extend approximately 14,400 km from South Africa to Portugal. The purpose of the project is to increase the overall capacity for transmission of telecommunications data (ie bandwith) in countries along the Atlantic seaboard of Africa. ERM has been contracted to support environmental permitting for a number of the landing countries for the WACS project. ERM is leading the environmental and permitting studies, with assistance from local environmental, socioeconomic and legal specialists. The work includes undertaking ESIA studies, stakeholder engagement and other permit applications, as required, in ten countries of the 13 WACS participatory countries. As the task manager for Angola, responsibilities included

management of environmental and social baseline studies, impact assessment, management plan preparation and stakeholder engagement.

Environmental Management Programme (EMPr) for Exploration in the Ultra Deepwater Orange Basin Block, Shell, South Africa, 2010.
South Africa's Mineral and Petroleum Resources Development Act requires an Environmental Management Programme (EMPr) to be compiled and submitted to the Petroleum Agency South Africa as part of an application for an Exploration Right. Shell appointed ERM to develop the EMPr. Responsibilities included developing the EMPr including the preparation of Environmental Management Plans (EMPs) for seismic surveys and prospect well drilling.

Ndian River Block EBS and 2D Seismic ESIA, Kosmos Energy Cameroon HC, Cameroon, 2008 – 2009.
Kosmos Energy Cameroon HC is the operator of the Ndian River Block located onshore in the northern part of the Rio Del Rey sedimentary basin in the Republic of Cameroon. Kosmos is currently planning a 2D seismic acquisition program to delineate prospectivity in the Southern part of the Ndian River Block. ERM was commissioned to conduct an Environmental Baseline Study (EBS) and an Environmental and Social Impact Assessment (ESIA) and the associated Environmental Management Plan (EMP) in preparation for the planned 2D seismic acquisition by the end of 2009. As project manager responsibilities included client liaison, integrative writing, financial management and coordinating specialist team.

ESIA for an Early Production System (EPS) for Kaiso-Tonya Area, Exploration Area 2, Tullow Uganda Operations Pty Ltd, Uganda, 2007 – 2008.
ERM was appointed to undertake an Environmental and Social Impact Assessment (ESIA) for an Early Production System. Tullow has an MoU with the Government of Uganda to develop an onshore EPS – the first oil production in Uganda. As project manager, responsibilities included overall coordination and management of the project, integrative writing of the ESIA, attendance of public meetings and workshops in-country and coordinating specialist team.

Environmental, Social and Health Impact Assessment (ESHIA),Angola LNG, Angola, 2005 – 2006.
ChevronTexaco and Sonangol are leading the development of the Angola LNG project. The project is an integrated gas utilisation project, taking gas from offshore production facilities to an LNG plant at Kwanda Base, in north-western Angola. Following on from site selection work conducted in 2002-2004, ERM was awarded the contract for completing a full Environmental, Social and Health Impact Assessment (ESHIA). Responsible for managing all social baseline data collection and analysis, stakeholder consultation and engagement and coordinating specialist team.

EIA for Block 9 and 21, Cobalt International Energy, L.P., Angola, 2010.
ERM was appointed to undertake an EIA for Block 9 and 21 according to regulatory requirements, and preparation of management plans.

EIA for Block 8 and 23, Maersk Oil Angola AS, Angola 2009.
Maersk Oil Angola AS entered into a Production Sharing Agreement (PSA) for Blocks 8 and 23 located at Kwanza Sul province, offshore Angola. Maersk is responsible for conducting an exploration program comprising seismic acquisition and the drilling exploratory wells in Block 8 and 23. ERM was appointed to undertake an EIA for these blocks according to regulatory requirements, preparation of management plans and oil spill and cuttings discharge modelling.

Compliance Audit

World Commission on Dams (WCD) Compliance Assessment of Bujagali Hyropower Power Project, Bujagali Energy Limited, September – October 2010.
ERM has been appointed to conduct a World Commission on Dams (WCD) assessment and Clean Development Mechanism (CDM) validation for the Bujagali Hydropower Project. Responsiblilties included a site visit in order to conduct a compliance assessment highlighting the gaps between existing conditions and referenced WCD guidelines and corrective action requests to address significant non-compliance issues.

Screening and Site Selection

High Level Screening Study, InfraCo Management Services Limited, Uganda, 2010.
ERM was commissioned to undertake a high-level screening of the key environmental and social

sensitivities in order to assist in early stage project design. The Project includes the provision of clean water, power supply and lake transport to unserved communities in Lake Albert Uganda.

Screening and Site Selection Study, Saldanha Bay, South Africa, Ilithia Group Holdings, 2009.
ERM was appointed by Ilithia Group Holdings to evaluate alternative sites for marine and land-based sites for an LPG Import Facility at Saldanha Bay. Working with marine and land-based engineers, the Screening and Site Selection Study aimed to demonstrate due-process and balanced evaluation of the social and environmental considerations in selecting the preferred alternative sites.

Screening and Site Selection Study, Port of Saldanha, South Africa, Transnet, 2008.
ERM was appointed by HMG Joint Venture (on behalf of Transnet) to undertake a Screening Study to evaluate alternative berthing options for the future development of the Iron Ore Terminal at the Port of Saldanha. The Screening Study aimed to demonstrate due-process and balanced evaluation of social, environmental, engineering, planning and financial considerations in selecting the preferred berthing option currently included in the Phase 2 Port EIA. As project manager responsibilities included overall coordination and administration of the project and integrative writing, and coordinating specialist team.

Screening Study for the Gauteng Basin Plan Studies, Transnet, South Africa, 2007.
Responsible for providing social specialist input on one of the 16 high level strategic environmental and social screening studies for the Gauteng Basin Plan Studies.

International Development

West Africa and South East Asia: Forest Law Enforcement, Governance and Trade (FLEGT), European Commission, DG Development, 2005 – 2006.
The Action Plan for Forest Law Enforcement, Governance and Trade (FLEGT) sets out how the EU aims to work in partnership with wood-producing countries to combat illegal logging and reduce the trade in illegally harvested timber. An inter-service group within the European Commission develops EU FLEGT policy lead by the Directorate General for Development (DG DEV). ERM is collaborating with DG DEV to keep the EU FLEGT process on track to meet political and public expectations. Responsibilities included providing a range of technical inputs including the contribution of policy papers on development co-operation in order to drive forward the country dialogues on Voluntary Partnership Agreements (VPAs) with member states and partner countries.

Ghana, South Africa: Millennium Development Goal (MDG)s Water and Sanitation Review, UK's Department for International Development (DFID), 2005.
ERM lead the preparation for DFID of a report focused on the performance of the water and sanitation sectors in relation to the Millennium Development Goal's for 12 countries in Africa and Asia. This sharing of experiences and developing of common concepts and principles was used to guide the process of planning, implementing and maintaining water supply and sanitation improvements helping form part of DFID's material for Commission on Sustainable Development (CSD) 13. Responsibilities included carrying out the in-country study in Ghana gathering and analysing data on how Ghana is progressing towards meeting the water MDGs.

Sierra Leone: Environmental screening and appraisal, UK's Department for International Development (DFID), 2006.
Undertook an environmental screening and appraisal of the Malaria Outreach and Safety Initiative (MOSI) project in Sierra Leone. Responsible for producing a DFID environmental screening note (ESN) for the proposed intervention as well as associated environmental appraisal text for the project memorandum, and liaising with relevant country programme office.

Signed by Zoe Day:

Dean Alborough

Consultant, Impact Assessment & Planning

Dean Alborough is a Consultant Level II in the **Impact Assessment and Planning Team** within ERM Southern Africa based in Cape Town, South Africa.

Dean has gained experience in oil and gas and renewables (with a focus on wind and solar energy) ESIAs with a key role in project management, coordinating and integrating specialist findings, checking compliance and standardization with assessment methodology, and reporting. Dean has completed numerous renewable (wind and solar) EIAs over the past few years. He has a good understanding of the full range of implications of upstream oil and gas and renewable energy projects on the environment.

Dean has more than four years experience in integrated environmental management, having worked on projects in the oil and gas, and renewable energy industries, and more than seven years experience in Environmental Science. His work experience has included environmental impact assessments, environmental management plans, environmental auditing and risk assessments.

Fields of Competence

- Programme management
- Project management (Waterfall and Agile methodologies)
- Environmental Impact Assessments
- Environmental Management Plans
- Complex Systems and Resilience Theory
- Environmental aspects of biotechnology
- Expert Systems
- Biodiveristy Impact Assessments and Plans

Education

- Masters of Science (Environmental Science and Biotechnology), University of Cape Town, South Africa, 2007
- Postgraduate Certificate in Project Management, University of Cape Town, South Africa, 2006
- Bachelor of Science Honours (Integrated Environmental Management) University of Cape Town, South Africa, 2003
- Bachelor of Science (Zoology and Environmental and Geographical Science), University of Cape Town, South Africa, 2002
- Biodiversity Offsets Course, 2012

Languages

- English
- Afrikaans (read and write)

Key Industry Sectors

- Renewables (Wind and Solar Energy Projects)
- Oil & Gas
- Power utilities

Key projects:

EIA for 90MW solar farm at Drennan in the Eastern Cape, 2012.
Projet Manager
ERM was commissioned to undertake an Environmental Impact Assessment (EIA) for a proposed Photovoltaic Solar Farm located at Drennan near Cradock in the Eastern Cape province, South Africa. The proposed facility will make use of photovoltaic arrays to generate solar power, with a output capacity of approximately 90MW. A comprehensive public participation process was developed and facilitated by ERM. Potential impacts of the proposed project were assessed by a number of specialist studies including; avifauna, other fauna, vegetation, as well as a visual impact assessment, social study a comprehensive cultural heritage study. ERM was responsible for the project management and integration of the specialist studies into the Environmental Impact Assessment and compiling an Environmental Management Plan for the facility

EIA for 90MW solar farm at Genoegsaam in the Eastern Cape Cape, 2012.
Projet Manager
ERM was commissioned to undertake an Environmental Impact Assessment (EIA) for a proposed Photovoltaic Solar Farm located at Genoegsaam near Cradock in the Eastern Cape province, South Africa. The proposed facility will make use of photovoltaic arrays to generate solar power, with a output capacity of approximately 90MW. A comprehensive public participation process was developed and facilitated by ERM. Potential impacts of the proposed project were assessed by a number of specialist studies including; avifauna, other fauna, vegetation, as well as a visual impact assessment, social study a comprehensive cultural heritage study. ERM was responsible for the project management and integration of the specialist studies into the Environmental Impact Assessment and compiling an Environmental Management Plan for the facility

EIA for 90MW solar farm at Graspan in the Northern Cape, 2012.
Projet Manager
ERM was commissioned to undertake an Environmental Impact Assessment (EIA) for a proposed Photovoltaic Solar Farm located at Graspan near Hopetown in the Northern Cape province, South Africa. The proposed facility will make use of photovoltaic arrays to generate solar power, with a output capacity of approximately 90MW. A comprehensive public participation process was developed and facilitated by ERM. Potential impacts of the proposed project were assessed by a number of specialist studies including; avifauna, other fauna, vegetation, as well as a visual impact assessment, social study a comprehensive cultural heritage study. ERM was responsible for the project management and integration of the specialist studies into the Environmental Impact Assessment and compiling an Environmental Management Plan for the facility

EIA for 100MW solar farm at Southdrift in the Free State Cape, 2011.
Assistant Projet Manager
ERM was commissioned to undertake an Environmental Impact Assessment (EIA) for a proposed Photovoltaic Solar Farm located at Southdrift near Bloemfontein in the Free State province, South Africa. The proposed facility will make use of photovoltaic arrays to generate solar power, with a output capacity of approximately 100MW. A comprehensive public participation process was developed and facilitated by ERM. Potential impacts of the proposed project were assessed by a number of specialist studies including; avifauna, other fauna, vegetation, as well as a visual impact assessment, social study a comprehensive cultural heritage study. ERM was responsible for the project management and integration of the specialist studies into the Environmental Impact Assessment and compiling an Environmental Management Plan for the facility.

EIA for 160MW solar farm at Groenwater in the Northern Cape, 2011.
Assistant Projetc Manager
ERM was commissioned to undertake an Environmental Impact Assessment (EIA) for a proposed Photovoltaic Solar Farm located at Groenwater near Potmasburg in the Northern Cape province, South Africa. The proposed facility will make use of photovoltaic arrays to generate solar power, with a output capacity of approximately 160MW. A comprehensive public participation process was developed and facilitated by ERM. Potential impacts of the proposed project were assessed by a number of specialist studies including; avifauna, other fauna, vegetation, as well as a visual impact assessment, social study a comprehensive cultural heritage study. ERM was responsible for the project management and integration of the specialist studies into the Environmental Impact Assessment and compiling an Environmental Management Plan for the facility. .

ESIA for a 3D Seismic Survey in Jobi Rii and Jobi East Survey Areas, Exploration Area 1, Uganda, 2011-2012.
Assistant Project Manager
ERM was commissioned to undertake the Scoping/ESIA for a proposed 3D seismic survey for oil exploration in the Jobi Rii and Jobi East Survey Areas. Responsibilities included report writing, specialist coordination, specialist review and assisting in project management functions.

ESIA for a 3D Seismic Survey in Mpyo-Bbegeri Survey Area, Exploration Area 1, Uganda, 2011-2012.
Assistant Project Manager
ERM was commissioned to undertake the Scoping/ESIA for a proposed 3D seismic survey for oil exploration in the Mpyo-Bbegeri Survey Area. Responsibilities included report writing, specialist coordination, specialist review and assisting in project management functions.

ESIA for the Liwenyi #1 Well Exploration Drilling, Ndian River Block, Cameroon, 2011.
Consultant
ERM was commissioned to undertake the Scoping/ESIA for a proposed drilling of an oil exploration well in the Ndian River Block. Responsibilities included report writing, specialist coordination, specialist review and assisting in project management functions.

EIA for 120MW wind farm at Witberg in the Western Cape, Finalisation, 2011.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed wind farm facility. Responsibilities included report writing, specialist coordination, specialist review, liaison with local, provincial and national environmental authorities. Involvement included the stakeholder engagement component associated with this EIA, including public meetings.

EIA for 36MW wind farm at Klawer in the Western Cape, 2011.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed wind farm facility. Responsibilities included report writing, specialist coordination, specialist review, liaison with local, provincial and national environmental authorities. Involvement included the stakeholder engagement component associated with this EIA, including public meetings.

EIA for 54MW wind farm at Lamberts Bay in the Western Cape, 2011.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed wind farm facility. Responsibilities included report writing, specialist coordination, specialist review, liaison with local, provincial and national environmental authorities. Involvement included the stakeholder engagement component associated with this EIA.

EIA for a 670MW renewable energy facility south of Sutherland in the Western and Northern Cape, 2011.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed renewable energy facility incorporating wind and photovoltaic power generating technologies. Responsibilities included specialist study review and impact assessment report writing.

EIA for a 500MW renewable energy facility south of Beaufort West in the Western Cape, 2011.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed renewable energy facility incorporating wind and photovoltaic power generating technologies. Responsibilities included specialist study review and impact assessment report writing.

EIA for a 1200MW renewable energy facility south east of Victoria West in the Northern Cape, 2010.
Consultant
ERM was commissioned to undertake a Scoping/EIA for a proposed renewable energy facility incorporating wind and photovoltaic power generating technologies. Responsibilities included specialist study review and impact assessment report writing.

Web-based Environmental Participation Application, South Africa, SDK Technologies, 2008-2010
Functional Design Lead and Project Manager
Responsible for building a web-based software application for the public participation and engagement process required in the environmental industry. Activities included the scoping, design and prototyping of the functional requirements, research and delivery of web-based best practices. Project control included scoping, design and development phases.

Shell Verification and Valuation, and Network Environmental Risk Assessment, South Africa, Shell, 2010
Consultant
Undertook field work and reporting for the asset verification, valuation and network environmental risk assessment of Shell assets. The role entailed coordinating site visits and reporting requirements, quality control of report deliverables and submission of the required deliverables.

Shell NEMA Rectification, South Africa, Shell, 2007/2008
Consultant
Involved in undertaking site visits, report writing and the submission of rectification reports for the Limpopo, Gauteng and Mpumalanga provinces. The role entailed coordinating site visits and reporting requirements, project database management, quality control of report deliverables, authority liaison and submission of the required deliverables.

Shell NEMA Auditing, South Africa, Shell, 2007/2008
Consultant
Involved in basic environmental auditing for Shell NEMA sites in Gauteng. The role entailed coordinating site visits and reporting requirements, quality control of report deliverables, authority liaison and the submission of the required audit deliverables.

Janet Mkhabela

Consultant II
Impact Assessment and Planning (IAP)

Janet Mkhabela is a Consultant with the Impact Assessment and Planning (IAP) team based in the Cape Town office. She has five years experience in the field of stakeholder consultation, social impact assessments and research. She has working mainly in the oil and gas, renewable energy (wind and solar) transport sectors (passenger trains, airports and freight rail).

Janet has managed and coordinated numerous stakeholder engagement processes. She has also been involved in designing and implementing stakeholder engagement processes related to large infrastructure developments and oil and gas projects. In addition, she has completed numerous high level desk-based researches and desk-based social impacts assessments.

Before joining ERM, Janet worked as a Junior Environmental Officer for the City of Cape, conducting research that examines South African environmental legislation for protected areas. She has also worked as an intern for the Western Cape Provincial Department of Environmental Affairs & Development Planning conducting research and policy development on renewable energy technologies, sustainable development, energy management, climate change and environmental education.

Furthermore, Janet is a Public Policy Partnership (PPP) fellowship member, an organisation that is dedicated in educating and training student who are interested and passionate about public sector excellence.

Fields of Competence

- Stakeholder Consultation/ Public Participation
- Research
- Social Impact Assessments

Education

- Master's Degree (Policy & Development Studies), University of KwaZulu-Natal, South Africa, 2005
- Honours Degree (Policy & Development Studies), University of Natal, South Africa, 2003
- Undergraduate Degree in Industrial, Organisational & Labour Studies: University of Cape Town, South Africa, 2003

Languages

- isiZulu
- isiXhosa
- English

Key Projects

Social Impact Assessment for the Principe Airport Expansion Project, Province of Principe, Republic of Sao Tome and Principe, HBD, 2011 – ongoing.
Project Specialist tasked with undertaking of the social impact assessment and stakeholder consultation. The SIA entailed gathering primary and secondary data, identification and assessment of impacts and development of appropriate mitigation measures whereas stakeholder consultation entailed facilitation and presentation of the project to five communities living in close proximity of the airport.

Social Impact Assessment for a Hydroelectric Power Plant, Zambia, joint venture (JV) between Lunsemfwa Hydro Power Company Limited (LHPC) and InfraCo Ltd, 2011 - ongoing.
Project Specialist for the social impact assessment for a hydroelectric power plant in the Central Province of Zambia. The SIA entailed working with local social specialist in gathering primary and secondary data, identification and assessment of impacts and development of appropriate mitigation measures.

Social Impact Assessment for Exploration of Oil in the Mokoko River Forest Reserve, Cameroon, Kosmos, 2011.
Project Specialist for the social impact assessment for exploration drilling for oil in Northwest Province of Cameroon. The SIA entailed working with local social specialist in gathering primary and secondary data, identification and assessment of impacts and development of appropriate mitigation measures.

Social Impact Assessment for a Glass Manufacturing Plant, Western Cape South Africa, Afriglass, 2011.
Project specialist tasks with the compilation of the social impact assessment for a glass manufacturing plant located in Atlantis, Western Cape South Africa. The SIA entailed the collection of primary and secondary data, identification and assessment of impacts and development of appropriate mitigation measures. Additional task performed for the Project included stakeholder identification, management and coordination of the stakeholder engagement for the EIA.

Social Impact Assessment for Solar Power Farms, Western and Northern Cape, South Africa, AES Solar, 2011 - ongoing.
Project specialist for the social impact assessment a solar power farm located in the Northern Cape Province of South Africa. The SIA entailed primary and secondary data collection, identification and assessment of impacts and development of appropriate mitigation measures. Also involved stakeholder identification and arranging of stakeholder consultation processes for the entire EIA.

High Level Review of an EIA process that failed in the Mapungubwe Region, Limpopo South Africa, Confidential 2011.
Compilation of a high level report regarding led to stakeholders taking an EIA to the high court for appeal against it and lessons learnt from this failed process.

Social Impact Assessment for 2 Solar Power Farms, Northern Cape and Free State, South Africa, Intikon Energy, 2010 - ongoing.
Social specialist for the social impact assessment for two solar power farms in the Northern Cape and Free State Provinces of South Africa. The SIA entailed primary and secondary data collection, identification and assessment of impacts and development of appropriate mitigation measures. Also involved arranging of stakeholder consultation process for the entire EIA.

Social Impact Assessment for 5 Wind Farms, Western and Northern Cape, South Africa, G7 Renewable Energies, 2010 - ongoing.
Project specialist for the social impact assessment for five individual wind farm sites located in the Western Cape and Northern Cape Provinces of South Africa. The SIA entailed primary and secondary data collection, identification and assessment of impacts and development of appropriate mitigation measures. Also involved stakeholder identification and arranging of stakeholder consultation processes for the entire EIA.

Social Impact Assessment for 8 Renewable Energy Facilities, Western and Northern Cape, South Africa, Mainstream Renewable Power South Africa, 2010 - ongoing.
Project Specialist for the social impact assessment for eight individual renewable energy facilities located in the Western Cape and Northern Cape Provinces of South Africa. The SIA entailed primary and secondary data collection, identification and assessment of impacts and development of appropriate mitigation measures.

Eskom Site Selection workshop, South Africa, 2010
The team was commission by Eskom to facilitate a planning workshop for one of its alternative energy teams. During the workshop we captured and reported on the outcomes of the workshop. The outcomes of the meeting were meant to inform planning and scheduling processes of projects.

Social Baseline, Risk Assessment and Stakeholder Engagement Strategy, Anglo Coal Botswana, Botswana, 2009-2010

Project consultant tasked with compiling a baseline description and risk assessment report. The research for this document was desktop based for different locations where Anglo is exploring the potential mining prospects for Coal-based Methane.

Cape Town Station 2030 Project, Intersite/PRASSA, South Africa, 2009 – to present
Assisting with the organisation of high level stakeholder engagement process regarding the potential sinking of railway lines and creating underground tunnels and freeing 35 city blocks of land.

The IRT project in Cape Town South Africa, 2008-2009

Identification of communities likely to be impacted by the introduction of the Bus Rapid Transit system in Cape Town metropolitan area. This lead to the engagement process of all stakeholders including authorities within the affected areas.

Transnet EIA Railway Upgrade from the Hotazel to the Port of Ngqura in South Africa, 2008 - 2009

Coordination of inputs and reporting on a high level study looking at potential environmental and social risks associated with proposed rail infrastructure upgrades.

Cape Town Station Revitalisation Project, South Africa, SARCC/ Intersite, South Africa, 2008- 2009.
This involved planning and organising stakeholder engagement processes for the revitalisation of Cape Town Station. Also involved engaging and constant interaction with informal traders regarding the upgrade as well as trying to find solution to the problems arising from the process.

Socio-Economic Impact Assessment for Offshore Exploration Well Drilling, Uganda, Tullow Oil, 2008
This involved researching and drafting baseline descriptions of the area, assessing the social and economic impacts of the construction, operation and decommissioning of the onshore facilities related to oil exploration and the storage yard to be constructed as well as the traffic related to these activities

Research of legal compliance for Land Treatment Units, Chevron, Multinationals, 2007
Examination of country legislation for the treatment of contaminated soils, providing a summary report to the clients of the legislation as well as establishing key contact persons.

Strategic Environmental and Social Overview of Rail Network development, South Africa, 2007- 2008
Identification and assessment of the social issues associated with the development of an improved rail network. Identification of these issues forms part of an overall risk assessment of a multitude of routes currently under consideration and allows for early identification and avoidance of key social risks.

Evaluation of the legal alternatives for the declaration of a protected natural environment status for the False Bay Ecology Park, Cape Town, South Africa, 2007
Examination of South African environmental legislation, contact with all relevant informants and stakeholders, collection of relevant information through interviews, writing a report and making a recommendation on which status is best fitting to the area.

Research and Policy Development for the Department of Environmental Affairs and Development Planning, Western Cape Province, South Africa, 2006/7
Review and feedback on the following key documents, as developed for Provincial Government:

- *Sustainable Development Implementation Plan:* provided a common understanding of sustainable development; highlighted sustainable development principles and provided information on provincial policies, strategies, programmes and plans as well as increasing stakeholder engagement to meeting sustainability targets and goals.
- *A Guide to Energy Management for Public Buildings*: set out guidelines on how to manage energy in public buildings, provided energy efficiency advice as well as a checklist for energy management.
- *Integrated Energy Strategy:* created a sound energy policy & programmes, addressed environmental concerns, climate change, secure clean sources of energy and renewable energy and partnerships.

A study on services delivery in the Western Cape Health Department, South Africa, 2002
Data collection, entering, coding, analysis and interpretation using Excel. A needs assessment study for provisions of staffing, determining which months, days and hours are busiest and determining the general needs of users.

Warren McCleland

Flora and Fauna Specialist
Ecorex

Warren McCleland is a sub-consultant to ERM. He has 15 years' experience in conducting baseline surveys, data analysis and report writing in various biomes in southern and tropical Africa, particularly savannah, forest and grassland biomes.

Warren has a specialist knowledge of identification of plants, mammals, birds, reptiles and frogs. He has experience in reporting according to IFC Performance Standards for numerous international projects in Sierra Leone, Guinea, Democratic Republic of Congo, Tanzania, Malawi, Mali, Mozambique and Zambia.

Fields of Competence

- Terrestial Ecology
- Project Management

Professional Affiliations & Registrations

- Herpetological Association of Africa
- South African Association of Botanists
- International Association for Impact Assessment (SA)
- African Bird Club
- BirdLife South Africa
- Mpumalanga Plant Specialist Group
- Botanical Society of South Africa

Education

- BSc Hons (Environmental Science), University North West (currently on hold due to work commitments).
- National Diploma (Nature Conservation), Cape Technikon, 1993

Languages

- English
- Afrikaans
- Zulu

Employment Record:

2005 – present
ECOREX Consulting Ecologists CC
Ecologist; Director

2002 - 2005
Lawson's Birding Tours
Specialist Guide

2000 - 2001
Escarpment Ecological Consultants cc
Founder Director

1996 – 2000
Crystal Springs Game Reserve
Reserve Manager

1995
Mutemwa Lodge, western Zambia
Lodge manager, guide

1993 - 1994
Natal Parks Board
Cadet field ranger

Key Experience:

SADC Region

Democratic Republic of the Congo
Biodiversity Baseline Study for Ulindi Hydropower Scheme, Itombwe Mts, Kivu South

Biodiversity Baseline Study and Impact Assessment for Kinsevere Copper Mine, Lubumbashi

Tanzania
Biodiversity Baseline Study and Impact Assessment for Mkuju River Uranium Project, Selous Game Reserve, Songea

Zambia
Biodiversity Baseline Study and Impact Assessment for Lumwana Copper Mine, Solwezi

Biodiversity Baseline Study and Impact Assessment for Mulungushi Hydropower Project

Malawi
Terrestrial Ecology Survey of Kanyika Uranium Mine, Kasungu

Mozambique
Terrestrial Ecology of the Corumana Dam Project, Sabie, Maputo province

Terrestrial Ecology of the Ressano Garcia Weir Project, Ressano Garcia, Maputo province

Terrestrial Ecology of the Gorongosa Dam Project, Gorongosa, Sofala province

Biodiversity Baseline Study and Impact Assessment for the Muanza Quarry, Gorongosa NP, Sofala province

Namibia
Biodiversity Baseline Study and Impact Assessment for Neckartal Dam, Keetmanshoop

Zimbabwe
Biodiversity Baseline Study and Impact Assessment for Bokai Platinum Mine, Gweru

South Africa
Biodiversity Baseline Study and Impact Assessment for Hoogland Chrome Mine, Steenkampsberg Mts

Biodiversity Baseline Study and Impact Assessment for Moonlight Iron Ore Mine, Tom Burke

Setting Conservation Targets for Threatened Birds in Mpumalanga

Biodiversity chapter of the Nkangala State of the Environment Report

Assessment of the status of *Pelargonium sidoides* and harvesting potential in Lesotho and South Africa

Terrestrial Ecology Study for the Groot Letaba Water Resource Development Scheme, Tzaneen

West Africa

Sierra Leone
Biodiversity Baseline Study and Impact Assessment for Marampa Iron Ore Mine, Lunsar

Republic of Guinea
Review of Specialist Studies conducted for an EIA for an aluminium mine near Bel-Air, in Bofa Prefecture.

Mali
Biodiversity Baseline Study and Impact Assessment for Fekola Gold Mine, Fedougou

Robin Clanahan

Civil Engineer / Environmental Manager
C.R.H. Clanahan & Associates

Robin Clanahan has 50 years experience in civil engineering, covering design and project management of dams, water reticulation and treatment, irrigation, hydrology, hydraulics, roads and other infrastructure. He also has experience in the associated environmental assessments and mitigation as well as financial and administrative management.

Specific experience includes water resources management, design and project management of dams, dam safety, canals and control structures, hydraulic modelling; hydropower and pumped storage; flood investigations and hydrology; environmental flow requirements; tunnels and underground works; rock mechanics; bulk water supply and reticulation; water treatment; pumping installations, pipelines and reservoirs; urban reticulation; borehole and wellfield development; housing and infrastructure, environmental impact assessment, resettlement and compensation.

Fields of Competence

- Civil Engineering (specifically related to dams, hydraulics, and roads).
- Environmental, financial and administrative management

Professional Affiliations & Registrations

- Fellow Water Institute of South Africa WISA 2000
- Member Chartered Institute of Water and Environmental Management; CIWEM, UK 1984
- Member South African Institution of Civil Engineers (SAICE), 1972
- Member South African National Group on Rock Mechanics, 1972
- Chartered Engineer, United Kingdom, 1969
- Member, Chartered Institution of Civil Engineers, ICE UK, 1969

Education

- MPhil (Environmental Management, University of Stellenbosch, 2003
- GSB (Construction Management programme), University of Cape Town, 1977
- BSc (Civil Engineering), University of Cape Town, 1961

Languages

- English
- Afrikaans
- French

Key Industry Sectors

- Renewables (Wind and Solar Energy Projects)
- Oil & Gas
- Power utilities

Key Experience:

C.R.H. Clanahan & Associates
Consulting Engineer
2003-2012

C.R.H. Clanahan & Associates is a private practice, currently working solo or with other consulting individuals or groups on dam safety and rehabilitation, bulk water supply and river hydraulics, constructed wetlands and domestic effluent. Projects include:

- Spring Grove Dam : TCTA Environmental Review Panel for construction, relocation and compensation – 2010-ongoing
- Nhlaralumi River Eco-hydrological study to address the license application to remediate four dams that failed under extreme flood in early 2012.
- Sub-consultant to Wellfield Consulting Service, Gaborone, Botswana, in the determination of Instream flow requirements for release recommendations below dams in two ephemeral rivers. This included development of a spreadsheet model for determining the effects of different release options on the dam operation.
- SADC SWID training team – resource social consultant; 2009 - 2011
- RSA DWA : Subconsultant to Knight Piesold – review safety of 4 of 7 dams in Eastern Cape and specify / design remedial and rehabilitation measures. 2007-ongoing, R60 million combined.
- RSA DWA : Subconsultant to Goba-ARQ; Resident Engineer on rehabilitation of Acornhoek Dam, Limpopo, 2007-2009 R30 million.
- Witbank Dam (Category III), Emalahleni, Dam Safety inspection team leader, 2006-ongoing.
- Subconsultant to Roche inc, Canada, Due Diligence review and reporting to Millennium Challenge Corporation on schools and roads development in northern Namibia and accommodation in northern National Parks.
- Twin City Development : Hazeyview: 2007-2008; reporting on environmental degradation by run-off from mall development and proposals for remediation.
- York Timbers; Sabi, Driekop, Jessievale, Roburnia, Nicholson & Mullin, Modiba and Golden Rhino Timber Mills : with Nepid Consultants, IWWM reporting, application and design of required stormwater and waste issues.
- desk study SEA for the mid-Zambezi river catchment, with SAIEA, Namibia,
- Rorich / EasyGrow : White River: small weir with innovative low cost fish ladder . 2008
- SADC : Core consultant team member on the Regional Strategic Water Infrastructure Development Programme. 2005.
- SADC : Specialist consultant : Regional Water Strategy 2005
- Lebombo Dam : UVS - dam safety and seepage remediation. 2004 -2007
- White River Estates canal review 2005
- SADC book chapter on KOBWA 2005
- Delta EMD process water review 2004-2005
- Plath dam raising 2005
- Da Gama Dam : Safety Inspection 2007
- Mbombela Erosion Assessment 2005
- GTZ / UNDP Initiative on Dams and Development : SADC Report on Key Dams Issues 2003
- Spago Dam – Dam Safety team leader- ongoing rehabilitation, with DMV Consulting Engs.Inc. 1996-current
- Malelane Pumpstation; Crocodile River rehabilitation (TSB), With DMV Consulting Engs.Inc. 2000-2005
- Kabokweni sewage dams failures investigation 2003-2005
- Grimman Weir failure – 2000-2005
- SAPPI Villages sewerage rehabilitation (SAPPI) 2002-2005
- uShaka Island Life Support Systems: temporary sea intake steelwork and sand exclusion. 2007-2008: pipework – hanger and corrosion review. 2003-2004
- Vergenoeg Dam; Tubatse Dam; Swartvlei Dam; Kaalrug Dam, Mvutshini Dam – ongoing dam safety
- Msauli Mine closure – Dam Safety assessment – 2004-2005, ongoing

Afridev Associates & C.R.H. Clanahan & Associates
Director & Principal
2000-2003

- AfriDev Associates is an environmental consultancy, calling on a wide range of expertise covering social, agricultural, estuarine and riverine

disciplines. Projects undertaken with AfriDev Associates and its subsidiaries JTK Associates and AfriDev Consultants, include :

- Komati-Mbuluzi Catchment – Assessment of water Resources Availability (Swaziland MNRE) 2002
- Caprivi Sugar Sector Project EA. (Namibia MAWRD)2002-2004 – Deputy Project Leader and Team Leader for all engineering and associated disciplines, reporting on all water delivery issues.
- Lake Liambezi (Caprivi) Recharge EA (Namibia MAWRD) 2002-2004 - Deputy Project Leader and Team Leader for all engineering and associated disciplines, reporting on all bulk water development issues.
- Komati River EWR assessment (DWA&F) 2003-current
- Mbombela State of Environment Report (Mbombela) 2003-2004, (subconsultant through Africon).
- Tsumeb Aquifer Abstraction EA (NamWater) 2003-2004

Komati Basin Water Authority (KOBWA)
Chief Executive Officer
1993-2000

KOBWA is a joint RSA - Swaziland development authority embodied by international treaty to implement Phase I of the Komati Basin Development. This position required inter alia –

- Setting up *ab initio* the KOBWA structure, including conditions of staff service, accounting systems, banking etc.;
- Project Management of large dam construction (Driekoppies Dam – R520 million / US$ 85 million and Maguga Dam and advanced infrastructure - R 980 million / US$ 140 million) as the owner / client representative;
- Pressure negotiation / liaison with Government bodies in RSA and Swaziland to effect implementation of relocation and compensation for land evacuation programmes and approval of financial dealings (combined - R 180 million / US$ 30 million);
- Compiling comprehensive and detailed budgets for both governments;
- Full financial management;
- Dealing with local authorities on access, relocation and compensation issues;
- Negotiating with the Development Bank of Southern Africa and other potential lending agencies on the provision and terms of project finance;
- Instructing and supervising the employment of national and international engineering and environmental / sociological consultants for separable parts of the Works, including drafting Terms of Reference and Requests for Proposals from Consultants; covering *inter alia :*
- Environmental (including sociological and socio-economic) base studies and impact assessments
- Hydrological and In-stream Flow requirement studies and definition,
- Major roads and bridges,
- Large dam design, including hydropower components,
- Housing, Township development and associated infrastructure,
- Relocation and compensation of affected communities
- Negotiating and putting in place specialist consultants for finance procurement and management;
- Initiating and supervising Public Relations drives;
- Determination and motivation of all KOBWA activities and establishment;
- Providing and managing all information for Board and liaison meetings;
- Supervising and instructing technical staff on in-house feasibility studies for alternative dam designs;
- Instructing Principal Controlled insurances of the Works and construction plant.
- In conjunction with the Dept. of Water Affairs and Forestry, initiating integrated catchment management forums for the formation of a Catchment Management Agency for the South African sector of the international Komati Basin.
- Participating in the international Tripartite Permanent Technical Committee working group for the formulation of rules for the Incomati (Komati) river catchment operation and management.

At the same time and with the permission of the KOBWA Board, appointed as the Approved Professional Engineer to carry out dam safety inspections, design and construction or rehabilitation supervision of :

- Category II Tubatse Dam; Samancor- rehabilitation and raising : regional award for excellence, 1995 – 1998, and ongoing dam safety;
- Category III Spago Dam ; TSB Malelane – Dam Safety team leader- rehabilitation – 1999 and ongoing dam safety.
- Mvutshini Dam; Swartvlei Dam safety and rehabilitation.

C.R.H. Clanahan & Associates
Principal
1989-1993

Private practice, working alone or with other consulting groups carrying out the following -

- Continued assistance to international contractor on Hex River Tunnel arbitration, liasing with international experts;
- Construction administration, (mainly for B.S. Bergman & Partners);
- Analytical numerical examination and reporting on :
  - water chemistry,
  - wellfield behaviour and
  - rock mechanics;
- Wellfield abstraction and brine handling (Sua Pan, Botswana);
- Design development and fabrication supervision of 3,5m diameter circular saw for rock (dimension stone);
- Hydraulic model studies, earth dam and water treatment design;
- Turnkey tender for water abstraction, pumping plant and treatment works (offshore);
- Environmental reporting on industrial establishments; risk assessment iro OSH Act etc.
- Assistance to contractors on pipeline and tunnelling projects;
- Specialist Consultant to Development Bank of Southern Africa in bulk water supply and hydropower pumped storage;
- Design and supervision as Approved Professional Engineer of Category II dams.

B.S. Bergman & Partners
Director
1987-1989

- General office management and administration;
- Group computer usage management (technical and CAD);
- Financial projections;
- Design, tender documentation, and contract supervision of bulk water supply comprising :
- river abstraction, (surface and sub-sand) ;
- water treatment, and
- high rise pumps and pump stations,
- Dam design,
- Spillway reparation design.

Investigation into water quality and sedimentation problems from Karstic sources (Namibia).

C.R.H. Clanahan Consulting Engineer
Sole Proprietor
1986-1987

Private practice working alone or with other consulting groups carrying out the following -

- Discovery of documentation for evidence in contractual arbitration case for an international contractor (Hex River Rail Tunnel), liaising with international experts on rock mechanics and construction management;

Assistance to Contractors on tendering, alternative designs and claims on contractual matters and related to tunnelling or materials issues.

Hydroconsults later, Chunnett, Myburgh & Partners & then Chunnett Fourie and Partners
Partner
1970-1986

Partner from March 1975; financial manager from late 1978 to 1986. Resigned from the Partnership for mainly personal reasons. Carried out a number of duties as would be expected in a small partnership, inter alia -

- Financial management and staff management.
- Economic assessment, preliminary and detailed design (including hydraulics, surge, and rock mechanics), contract documentation and on site contract supervision of Ruacana Hydroelectric Power Station (320 MW).
- Water supply and water treatment;

- Feasibility studies on large scale irrigation schemes and hydroelectric pump storage schemes
- Preliminary designs on large and small dams;
- Computer programming.

Ministry of Water Development
Engineer
1962-1970

Engineer employed initially in the Hydrological Branch and subsequently in the Designs Branch, carrying out the following :

- Hydrology, including rewriting all departmental computer programmes, (machine language), and assisting with the development of a stochastic approach to dam yield analysis;
- Canal and dam design from reconnaissance through to final detailed design and construction supervision, both ex Head Office and as Assistant Resident Engineer and Resident Engineer; in charge of hydraulic model studies and laboratory management.

Kurt Barichievy

Hydrologist / Earth Scientist
SiVEST

Kurt Barichievy has been undertaking specialist soil assessments since 2007 and has gained experience throughout South Africa. He has extensive knowledge in soil classification, sampling and mapping.

Kurt also has experience in more specialised soil related activities such land use capability assessments, land use planning, soil impact assessments, soil erosion management plans and agricultural potential investigations. These skills have been applied in a variety of projects including power line and electrical infrastructure, mining applications, industrial facilities, housing and tourism developments, Environmental Management Frameworks and renewable energy facilities.

Fields of Competence

- Soil Surveys
- Agricultural Assessments
- GIS Technology

Professional Affiliations & Registrations

- Registered as a Professional Natural Scientist (*Pr. Sci. Nat.)* with the South African Council for Natural Scientific Professions - Earth Science (Registration No. 400129/11)
- Member of the Soil Science Society of South Africa

Education

- MSc (Hydrology), University of KwaZulu-Natal, 2006-2009
- BSc. Honours (Hydrology), University of KwaZulu-Natal, 2005
- BSc. (Hydrology and Environmental Science) University of KwaZulu-Natal, 2001-2004

Languages

- English
- Afrikaans

Key Projects

Soil Surveys, Agricultural Assessments and Specialist Input

- Spoornet Coal Link Desktop Agricultural Assessments, KZN (400 and 88 kV power lines)
- Eskom Delareyville Desktop Agricultural Assessment, North West Province (132 kV Power Lines)
- Eskom Vryburg (Mookodi Phase 1) Desktop Agricultural Assessment, North West Province (132 kV Power Lines)
- Eskom Thyspunt Transmission Line Integration Project Agricultural Assessment, Eastern Cape (400 kV Power Lines)
- Spoornet Coal Link EIA Phase Agricultural Assessments, KZN (400 and 88 kV power lines)
- Eskom Epsilon Substation Agricultural Assessment, North West
- Eskom West Rand Power Lines Agricultural Assessment, Gauteng
- Postmasburg 132kV Line Desktop Agricultural Assessment, Northern Cape
- Droogfontein Desktop Agricultural Assessment, Northern Cape
- Harvard Soutdrift Line Desktop Agricultural Assessment, Free State
- Postmasburg Power Lines Desktop Agricultural Assessment, Northern Cape
- TURGIS Bon Accord Nickel Mine Scoping Phase, Barberton, Mpumalanga (Soil and Land Use Assessment)
- Felixton Petrol Filling Station Agricultural Assessment, KZN
- Grootvlei Power Station Soil and Land Use Assessment, Mpumalanga
- LNG Plant Baseline Soil Assessment, Mozambique
- Ellingham Estate Soil and Agricultural Assessment, Park Rynie, KZN
- Redcliffe Soil and Agricultural Assessment, Verulam, KZN
- Farm Isonti Soil and Agricultural Assessment, Umzinto, KZN
- SAPPI Birdswood Soil and Agricultural Assessment, Richards Bay, KZN
- Lungisisa Village Soil and Agricultural Assessment, Hazelmere, KZN
- Kokstad Soil and Agricultural Assessment, KZN
- Nononti Development Feasibility Study, KZN
- Nononti EIA Phase Agricultural Assessment, KZN
- Mogale Gate Agricultural Assessment, Gauteng
- MRP Solar Energy Facilities Soil and Agricultural Assessment, Northern Cape (De Aar, Kimberley and Loeriesfontein)
- MRP Wind Farms Agricultural Assessment: Scoping Phase, Northern and Eastern Cape (Loeriesfontein, Lady Grey, Noupoort and Prieska)
- Copperton Wind Energy Facility Desktop Agricultural Assessment, Northern Cape
- Koekenaap Wind Energy Facility Agricultural Assessment, Western Cape
- MRP Wind Farms Agricultural Assessment: EIA Phase, Northern Cape (Prieska, Noupoort and Loeriesfontein)
- Copperton Solar Desktop Agricultural Assessment, Northern Cape
- De Aar Solar Agricultural Assessment, Northern Cape
- De Aar Wind Farm, Northern Cape
- MRP Wind and Solar Fatal Flaw Studies, Northern and Western Cape
- Genoegsaam and Graspan PV's Desktop Agricultural Assessments, Eastern and Northern Cape
- Genoegsaam and Graspan PV's EIA Phase Agricultural Assessments, Eastern and Northern Cape
- Kangnas Wind and Solar Energy Facilities, Near Springbok, Northern Cape
- Renosterberg Solar PV and Wind Farm Desktop Agricultural Assessment, Northern Cape
- Mogale City EMF, Gauteng
- Grantham Mixed Land Use Development Agricultural Assessment, KZN
- Mookodi Phase Two, Integration Project, North West Province
- Drennan Solar Park, Eastern Cape
- De Aar Power Lines, Northern Cape Province

In progress:

- Frankfort Power Lines, Free State
- Renosterberg EIA Phase Agricultural Assessment

Flood Lines and Hydrological Assessmesnts

- Umkomanzi Drift Flood Line Determination, KZN
- Canelands Flood Line Determination, KZN
- Ladysmith Shopping Centre Flood Line Determination, KZN
- Bergville Prison Flood Line Determination, KZN
- Shoprite Pine Town Flood Line Determination, KZN

    - Msunduzi Flood Line Determination, Pietermaritzburg, KZN
    - Pinetown Veterinary Quarantine Flood Line, KZN
- TURGIS Nickel Mine Flood Line, Barberton, Mpumalanga
- Unhlazuka Flood Lines, Richmond
- Durban Flood Risk Mapping, KZN
- Mbokodweni Flood Lines, KZN
- Mvuzane Rural Housing Flood Lines, KZN
- Dube Tradeport Flood Lines, KZN

In progress:

- Richards Bay Flood Lines, KZN
- Imbilo River Flood Lines, KZN

Stormwater Management Plans (SWAP)

- Montclair SWMP, Durban, KZN
- De Aar SWMP, Northern Cape
- Hibiscus Coast Cemeteries SWMP, KZN
- Glenwood SWMP, Durban, KZN
- Sundumbili, SMP, KZN
- ERF 747 EMP, KZN
- Wembezi SWMP, KZN

Wetland Related Projects and Specialist Input

- NMPP Wetland Audits, Gauteng and Mpumalanga
- Brentwood Quarry Wetland Assessment, Gauteng
- Eskom Cable Crossing Wetland Assessments, Gauteng
- Philani Valley Wetland Rehabilitation, Durban, KZN
- Eskom Johannesburg Strengthening Wetland Delineation, Gauteng
- Pomona Wetland Delineations, Gauteng
- Hammersdale Retail Wetland Water Budget, KZN
- Grootvlei Power Station Wetland Assessment, Mpumalanga
- Mogale's Gate Wetland Assessment, Gauteng
- Dube East Wetland Assessment, KZN
- Eskom DESD Wetland Assessment, KZN
- Port Edward PFS Wetland Assessment, KZN
- Newcastle Cemeteries Wetland Assessment, KZN
- Riverhorse Valley Wetland Assessment, KZN

In progress:

- Driefontein Pipeline near Ladysmith Wetland Assessment, KZN
- Durban Intergrated Rapid Transport Routes Wetland Assessment, KZN
- Tinley Manor South Wetland Rehabilitation, KZN
- Hyde Park Wetland Rehabilitation, KZN

Irrigation and Crop Water Demand Planning

- Nomalanga Estates, Greytown, KZN

Water Use Licencing

- Ladysmith pedestrian bridges, KZN
- Ndundulu Road, KZN

Jacob Chishiba

Environmental and Procedural Advisor

Jacob Chishiba is an industrial environmental economist based in Lusaka, Zambia.

He has over 20 years' experience in environmental management and has worked on many projects for the Lunsemfwa Hydro Power Company (LHPC).

Recent experience includes:

- Construction of a Power House at Johnson Valve at Mulungushi Dam & a 2 Kilometre Power Transmission Lines
- Upgrading and installation of No. 4 Turbine Generator at Lunsemfwa Hydro Power Station
- Construction of a 3km long canal for hydro power generation at Mulungushi Power Station.
- UNDP/GRZ Renewable Energy Project for the Environmental Framework for Bio-Fuels.
- Environmental Project Brief for Grid Extension for Lukulu North (Kasama), Mumbwa and Kaoma.
- Environmental Impact Assessment of Installation of Surface Fuel Tanks at Zambia Sugar Plc.
- Environmental Impact Assessment of Sugar Plantation Expansion Project.

Fields of Competence

- Project Management
- Environmental and Impact Assessment (EIA)

Professional Affiliations & Registrations

- Member of the Southern African Botanical Diversity Network
- Included on the Zambian Environmental Management Agency's (ZEMA) list of approved environmental practitioners.
- Former Board Member of the International Network of Green Planners (INGP) with secretariat based in the Netherlands.

Education

- MSc nvironmental Management and Policy from Lund University, Sweden, 1998.
- B.Sc. Natural Sciences: University of Zambia, (1985)

Languages

- English
- Bemba

Key Industry Sectors

- Power
- Transportation
- Natural Resources

Key Projects

Environmental Impact assessment (EIA) of the impacts of Construction of a Power House at Johnson Valve at Mulungushi Dam & 2 Kilometer Power Transmission Lines and development of environmental management plan, 2012.

EIA for the construction of a 3km long canal and development of environmental management plan, 2009.

Environmental assessment of an intermodal dry port in Chipata financed by the European Union under the Sugar accompanying measures facility, 2009.

Environmental Impact Assessment and preparation of an Environmental Management and Monitoring Plan to mitigate adverse effects for rehabilitation of Lusaka-Chirundu Road, 2009.

Undertaking socio-economic impact monitoring surveys of improved roads covering 3,634km in 30 districts (eight provinces) of Zambia and preparation of monitoring reports thereof, 2009.

Co-ordinating project activities, planning and undertaking the environmental and social environmental impact studies and preparation of the Environmental Management Plan and Resettlement Action Plan, 2009.

Development of an Action Plan resulting from comprehensive analytical evaluation, 2008.

Preparation of Environmental and Social Management Framework and Bio-Fuels, 2008.

Preparation of Environmental and Social Management Framework and Bio-Fuels, 2008.

Development of the Woodfuel and Sustainable Forestry Management Programme and Institutional Capacity Building Programme for the MTENR, 2007.

EIA and EMP to mitigate adverse effects for installation of surface fuel tanks, 2007.

Preparation of Environmental and Social Management Framework and Resettlement Policy Framework, 2006.

EIA and EMP to mitigate adverse effects for Zambia Sugar Expansion Project in Mazabuka. The assignment covered aspects of land preparation, plantation, irrigation and sugar cane processing at the factory, 2006.

EIA and EMP to mitigate adverse effects for Oil Palm Plantation Project in Mpika. The assignment covered aspects of land preparation, plantation and irrigation, 2006.

Production of report outlining options on trade and environment issues impacting on market access, environmental sustainability, sustainable development and, in particular, poverty reduction in Zambia, to serve as an input into the regional study, 2005.

Planning and managing all project activities, co-ordination of the team's work, guiding the study team on methods, techniques and survey of the environmental setting of the city and final preparation of the report, 2005.

Final Environmental Impact Evaluation Study of the Rehabilitation of the Mongu-Kalabo Road, 2005.

EIA and Development of Guidelines for Zambia Rural Small Works Programmes for Water and Food Security, 2004.

Final Environmental Impact Evaluation Study of the Rehabilitation of the Kabwe- Kapiri Mposhi and Chisamba Roads, 2003-2004.

EIA and EMP for the Lusaka-Chirundu & Zimba-Livingstones Roads, 2003-2004.

Undertaking environmental assessment of the pedicle road construction leading to thepreparation of environmental project brief with mitigation measures, 2004.

Environmental Baseline Study of the Lusaka-Mongu Road Corridor, 2004.

Environmental Impact Assessment for Lusaka-Mongu Road and Development of an Environmental Management and Monitoring Plan, 2004.

Preparation of an Environmental Project Brief for Artisanal Scale Copper Processing Plant in Kalulushi light Industrial Area and development of environmental management plan, 2004.

Environmental Assessment (EA) for the Copperbelt Feeder Roads covering all the ten Copperbelt towns namely: Ndola, Luanshya, Masaiti, Mpongwe, Kalulushi, Lufwanyama, Kitwe, Mufulira, Chingola and Chililabombwe, 2004.

Michiel Jonker

Freshwater Ecologist
Ecotone

Michiel Jonker is a partner at Ecotone Freshwater Consultants CC since 2008.

Michiel has been involved in a number flow related ecological assessments both nationally and abroad. These assessments ranged from proposed alteration in channel morphology, water quality and hydrology and mainly aimed at relating risks to aquatic responders such as diatoms, marcoinvertebrates and fish. Flow related projects include pipeline, power line, road, railway, silt and litter trap, treated waste water discharge and dam projects. Project localities include South Africa, Mozambique, Tanzania and Congo

Fields of Competence

- Freshwater Ecology
- Environmental Management

Professional Affiliations & Registrations

- 2009- Member of the International Association of Impact Assessment-SA (IAIA SA).
- 2009- 2011The South African Council for Natural Scientific Professions (SACNASP)
  Professional Natural Scientist
  Pr. Sci. Nat. (Zoological & Ecological Science)
  Registration number: 400275/12
- 2006- 2011 Member of the Zoological Society of Southern Africa (ZSSA)
- 2006- 2011 Member of the Southern African Society of Aquatic Scientists (SASAqS)

Education

- MSc (Environmental Management), University of Johannesburg, 2011
- MSc (Aquatic Health) *cum laude,* University of Johannesburg, 2009
- BSc Honours (Zoology) *cum laude,* University of Johannesburg, 2006
- BSc (Natural and Environmental Sciences), University of Johannesburg, 2005

Key Experience

- FFMES, Exxaro DMC Iron Congo Project, Aquatic specialist study, Mayoko, Republic of Congo (September 2012).
- GladAfrica, Centurion Lake Sediment Trap, Aquatic Specialist Study, Gauteng, South Africa (November, 2012).
- MSA, Meyerton Waste Water Treatment Works Upgrade, Aquatic Specialist Study, Gauteng, South Africa (November 2012).
- Eskom Majuba Ash Disposal Facility, Wetland Specialist Study for the Scoping/EIA, Mpumalanga, South Africa (September, 2012).
- Eskom Tutuka Ash Disposal Facility, Wetland Specialist Study for the EIA, Mpumalanga, South Africa (September, 2012).
- FFMES, Sintoukola Project, Aquatic specialist study, Republic of Congo (May 2012; July 2012).
- Coffey Environments, Tete Iron Project, Aquatic specialist study of the Revuboe River, Chiúta and Moatize districts, Tete, Mozambique (March 2012).
- Shanduka Coal, wetland and impact assessment for a proposed 400kV line relocation, Middleburg, Mpumalanga (April, 2012).
- Worldwide Coal Carolina, aquatic biomonitoring assessment, Carolina, Mpumalanga (March, 2012).
- Homeland Mining and Energy SA, proposed Eloff Opencast Mine, specialist wetland assessment (± 1400 ha) just outside the town of Delmas, Mpumalanga (February, 2012).
- Exxaro MagVanTi Project -Aquatic Ecology Baseline Study, Limpopo (January, 2012).
- Shanduka Coal, wetland and impact assessment of a pan located in the Graspan Colliery, Middleburg, Mpumalanga (January, 2012).
- Biodiversity Issues Related to Geological Exploration in Limpopo –(August 2011).
- African Barrick Gold North Mata Mine - Aquatic Consultant: Ecotoxicological risk assessment for discharge of treated waste water into the Mara River, North Mara, Tanzania (August, 2011).
- Aquatic Consultant- Impacto: Aquatic ecology assessment for proposed Moamba Dam Project, Moamba, Mozambique (July, 2011).
- Aquatic Consultant- Group five: Aquatic biological monitoring of a crude oil spill into the Malanspruit River and Metshezana Dam near Estcourt in KZN (June, 2011).
- Fresh water Ecology scoping study-Hendrina-Mpumalanga(May 2011)
- Aquatic Biomonitoring Assessment-Blesbokspruit- Hydro Testing (May 2011)
- Aquatic Consultant- Lidwala environmental and engineering consultants: Sanral N14 river/stream crossing aquatic assessment (May 2011).
- Aquatic Consultant- Randwater: Proposed water and treated water residue pipeline near Lethabo power station in Vereeniging (May 2011).
- Aquatic Consultant- Anglo Coal: Assessment on non-perennial drainage lines associated with proposed coal mining development near All days in Limpopo (May, 2011).
- Hydro Testing Biomonitoring(KP290+100) KwaZulu-Natal- Aquatic Ecology Assessment (Febuary 2011)
- Aquatic Consultant- Riversdale: Aquatic specialists on the Benga Coal Project, Tete, Mozambique (January, 2011).
- Aquatic Consultant- Transnet: Aquatic biomonitoring - Ladysmith pump station oil spill, Ladysmith, Natal (January, 2011).
- Hydrological Alteration-Aquatic Ecology Assessment-New Largo(July 2010)
- Aquatic Consultant – Imperata – Aquatic assessment for a proposed Rand Water pipeline crossing over the Pienaars River near Pretoria (May, 2010).
- Aquatic Consultant – Ekoinfo – Aquatic assessment for a NuCoal mine (Vuna colliery) near Middelburg Mpumalanga (March 2010-Current)
- Aquatic Consultant – EcoAgent – A MSA project – Detailed Aquatic assessment for the propped Veremo Magnetite mine in the Eastern Bushveld near Stofberg Mpumalanga (May 2010)
- Aquatic Consultant – New Multi Purpose Pipeline (NMPP) a combined Transnet, Group Five and Spiecapag project –Aquatic assessment and monitoring of associated river crossings in the Upper Vaal, Thukela and Mvoti Water Management Areas (Ocktober 2009- Current).
- Aquatic Consultant – Intergraded Landscape Architects – Raslouw Riparian delineation and aquatic assessment, Johannesburg (November 2009).
- Aquatic Consultant – Ekoinfo – Klipriviersberg Full Aquatic assessment (January. 2009)
- Aquatic Consultant – Ekoinfo – Lonmin Aquatic biodiversity assessment (January 2009).
- Aquatic Consultant – NSS– Optimum Coal Fish diversity assessment (March 2009)

- Aquatic Consultant –NSS – Rio Tinto Chapudi proposed coal mine diversity assessment (March 2009).
- Aquatic Consultant – Lonmin platinum- aquatic biodiversity assessment and action plan (January, 2009).
- Aquatic Consultant – SASOL – aquatic ecosystem impact assessment for proposed pipeline development (January 2009).
- Aquatic Consultant – Arcus Gibb - Aquatic biodiversity assessment for proposed coal Eskom Mulilo coal mining development (December 2008). **2011**
- Aquatic Consultant – ESKOM - Biomonitoring for proposed Majuba railroad construction for Eskom (October 2008- current).
- Junior Scientist – Enviross cc - Aquatic macro- 2009 invertebrate biodiversity study for proposed feedlot Mpumalanga 2007. (November 2007)
- Junior Scientist – Enviross cc - Tshwane sewerage works bio-monitoring. (September 2007).
- Junior Scientist – Econ@uj - Ecological state of 2008 five estuaries in the Wild coast for proposed heavy mineral mining (October 2007).
- Aquatic Consultant – Ekoinfo - Aquatic ecological assessment for proposed golf course development in North West province for Sun 2008 City (August 2007).
- Junior Scientist – Enviross cc - Firgrove industrial development in Somerset West 2007 (July 2007) 2007.
- Junior Scientist – Enviross cc - Aquatic health determination and eco-classification for ANGLO coal (Mpumalanga) in 2007 (2007).
- Junior Scientist – Econ@uj - Aquatic health 2007 determination and eco-classification for TOTAL coal in 2006 (May 2006).
- Junior Scientist – Econ@uj - Aquatic health and fish diversity assessment at Klipplaat nature reserve, 2006 (September 2006).
- Technical Assistant - University of 2006 Johannesburg Zoology department - Aquatic health and biodiversity of the Crocodile West Marico and Magaliesburg system, 2007 (February 2007).
- Technical Assistant – Enviross cc - Owl surveys (March 2007).
- Project Manager - University of Johannesburg Zoology department - Aquatic health and biodiversity of lake Chrissie in Mpumalanga, 2007 (April 2007)
- Technical Assistant - University of Johannesburg Zoology department - PhD study regarding effects of pesticides on the freshwater aquatic health in the Levubu River in Venda (Limpopo Province) (February 2008)
- Researcher - University of Johannesburg Zoology department - Presented poster at Zoological society South Africa (ZSSA) in July 2007: Abiotic factors influencing invertebrate community structures in pan and dams in the Mpumalanga highveld area (June 2007)

Workshops and Courses

Tools for Wetland Assessment Short Course
Department of Environmental Science Rhodes University; Grahamstown Port Elizabeth

Environmental Management Systems – WTH Management and Training ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg

Wetland and Riparian Delineation Course
Accredited wetland delineator Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF)
Pretoria, South Africa.

Skippers Course License Holder of a Category "R" skippers license

SASS5 Accredited Practitioner
Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux (North West Nature Conservation).

Multivariate Statistics Training
Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam

Advanced 4x4 driving course

Publications

- Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3).**

- De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. &

Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

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