



GOVERNMENT OF MALAWI

**MINISTRY OF AGRICULTURE, IRRIGATION AND
WATER DEVELOPMENT**

**SHIRE VALLEY TRANSFORMATION
PROGRAM**

**Environmental and Social Impact
Assessment (ESIA), Environmental
and Social Management Plan (ESMP)
and Pest Management Plan (PMP)**

Executive Summary

August 8, 2017

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA)
FOR THE SHIRE VALLEY IRRIGATION PROJECT (SVIP)
EXECUTIVE SUMMARY**

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List of Acronyms

ADD	Agricultural Development Division
Ca	Calcium
CC	Construction contractor
CBOs	Community Based Organizations
CMIP	Common Management Information Protocol
COB	Coyne and Bellier Study
DNPW	Department of National Parks and Wildlife
EC	Electrical Conductivity
EFR	Environmental Flow Requirement
EIA	Environmental Impact Assessment
Escom	Electricity Supply Commission of Malawi
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Exchangeable Sodium Percentage
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Discussion Group
FS	Feasibility Study
GCM	Global Climate Model
GEF	Global Environment Facility
GIEMS	Global Inundation Extent from Multi-Satellites
GoM	Government of Malawi
Ha	Hectares
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
JICA	Japan International Cooperation Agency
KRC	Korea Rural Corporation

LNP	Lengwe National Park
masl	Meters above sea level
Mg	Magnesium
MWK	Malawian Kwacha (1\$ US equals +/-715 MWK)
MoAIWD	Ministry of Agriculture, Irrigation and Water Development
MWR	Majete Wildlife Reserve
N	Nitrogen
NWDP	National Water Development Project
P	Phosphorus
PAPs	project-affected people
PCCPLTRPF	Preparation and implementation of a Communications, Community Participation, Land Tenure and Resettlement Policy Framework
pH	Soil Reaction
PMP	Pest Management Plan
PPE	Protective Personal Equipment
PPP	Public Private Partnership
RoW	Right-of-Way
SRBMP	Shire River Basin Management Program
STI(s)	Sexually transmitted infections
SVIP	Shire Valley Irrigation Project
SVTP	Shire Valley Transformation Project
TORs	Terms of Reference
UNESCO	United Nations Education Scientific and Cultural Organization
WASVIP	Water Availability for Shire Valley Irrigation Project
WESM	Wildlife and Environmental Society of Malawi
WRB	World Reference Base for Soil Resources

1. INTRODUCTION

This document is the Executive Summary of the Environmental and Social Impact Assessment report (ESIA) for the Shire Valley Irrigation Project (SVIP). The ESIA is presented in 3 volumes: The ESIA impact assessment itself, the Environmental and Social Management Plan (ESMP), and the Pest Management Plan (PMP). A Baseline Report was prepared as technical background information, and relevant sections have been included in the ESIA report itself. The ESIA was conducted for the full SVIP project (including SVIP 1 and SVIP 2 areas), while the ESMP was prepared for the area for the SVIP 1 project area only. When specifics of works for SVIP 2 area will be known in future phases of the program, a separate ESMP will be developed for the SVIP 2 area. Besides these documents, a Resettlement Policy Framework and a Process Framework have also been prepared. All documents are disclosed in country and on the World Bank website.

This document was commissioned by Ministry of Agriculture, Irrigation and Water Development (MoAIWD) of Malawi. Korea Rural Corporation (KRC) is the consultant that prepared the draft Feasibility Study (FS), and BRLi is the consultant that prepared the draft ESIA.

Measures developed under this assignment have informed the Government of Malawi and technical studies about ways to mitigate the adverse impacts and enhance the positive effects of the Project. The ESIA is based on the FS description of the Project. The ESIA and ESMP will be updated once the detailed engineering design is completed.

The program development objective for the Shire Valley Transformation Program is to improve the management and utilization of natural resources in a sustainable way to increase agricultural productivity and commercialization for targeted households in the Shire Valley. The program has three project phases to meet its objective. The Project objective for the first Phase Project is to provide access to reliable gravity-fed irrigation and drainage services, secure land tenure for smallholder farmers, and strengthen management of wetlands and protected areas in the Shire Valley.

The program addresses the agriculture, water, energy nexus in a landscape approach, aiming at irrigating about 43,370 ha of land in Chikwawa and Nsanje Districts, in order to increase their economic prospects and food security. It involves a water intake from the Shire River located within the Majete Wildlife Reserve (MWR) and three Main Canals of a total length of about 133 km.

As used in the ESIA (including ESMP and PMP) and in this Executive Summary, the Shire Valley Irrigation Project (SVIP) refers to the actual irrigation scheme, including the construction and operation of the irrigation works. The Shire Valley Transformation Program (SVTP) is the integrated program that supports SVIP as well as complementary development activities. As a practical matter, the terms SVIP and SVTP are often used interchangeably in the ESIA and other documents.

The first SVTP project, SVTP-I, corresponds to Phase I of the SVIP irrigation works (described further below), the associated on-farm development and land tenure activities. In addition, SVTP-I includes Component 2.2 on Natural Resources Management that will be supported largely with Global Environment Facility (GEF) funding. It will promote an inter-sectoral approach to the management of the Lower Shire landscape by addressing biodiversity conservation, protecting and enhancing the role forests, woodlands, rangelands and wetlands play in mitigating climate change, and promoting sustainable approaches to forest management which protect forest resources and deliver benefits to local communities.

The SVTP is expected to benefit much of the population of the Shire Valley, which is a major positive impact given the dry conditions that prevail in the area. Improving local livelihoods will lead to other indirect positive impacts: improved access to education and health, new opportunities for agribusiness, etc.

The SVTP-I project includes strong provisions to ensure its environmental soundness and mitigate adverse environmental impacts. To address the environmental challenges the SVTP-I project design includes, among others:

- Appropriate wording and inclusion of all applicable mitigation measures in the call for tender (and terms of references) and in the contract of the construction contractor including leverage such as non-payment clauses for non-compliance;
- Inclusion of all applicable mitigation measures in the bulk water operator's call for tender (and terms of reference) and contract;
- Selection of a construction contractor with a good reputation and who is environmentally and socially aware and responsible;
- Phasing, scheduling, and confining canal construction work within the Majete Wildlife Reserve (MWR) to minimize the impacts on tourism;
- Providing suitable compensation for impacts on tourism in MWR (a compensation plan is included in the ESMP);
- Installation of low maintenance and wildlife-friendly infrastructure in MWR, particularly a fish barrier to maintain the separation between the Lower Zambezi and the Upper Shire fish faunas; also long siphons (that facilitate wildlife passage over the Feeder Canal) within MWR; wildlife underpasses through generously-dimensioned culverts; wildlife watering points; noise barriers; wildlife-friendly Feeder Canal surface near MWR; and wildlife-proof walls around both sides of the Feeder Canal within MWR to prevent animals from getting stuck and drowning in the canal;
- Installation of sufficient livestock watering troughs and cattle bridges along the Main Canals; and
- Measures to prevent drownings of people (safety ladders) and treatment against schistosomiasis, as it is a common disease in tropical irrigation schemes.

In addition to these environmental mitigation measures, the Natural Resources Management Component of SVTP-I supports environmentally positive activities such as strengthening the protection and management of the Lengwe National Park Extension Area, Mwabvi and Majete Wildlife Reserves, Matandwe Forest Reserve, and Elephant Marsh. It is hoped that SVIP will serve as a positive example of how large-scale irrigation projects can be built and operated in a wildlife-friendly and environmentally sustainable manner.

2. PROJECT DESCRIPTION

The first project under the program (SVTP-I) will initiate the process of transformation of the Shire Valley and pave the way for agricultural commercialization and improved natural resource management at the landscape level. The indicative objectives for the second and third phases would be to increase agricultural productivity in targeted smallholder-owned commercial farm enterprises; support value chain and value addition; extend area supported with irrigation and farm development; and continue and expand efforts to address land degradation and sustainable management of forests, wetlands and protected areas.

The SVTP is a 14-year program (2017-2031) structured around three coordinated pillars:

- (i) Providing reliable, professionally managed and sustainably financed irrigation service to a large number of irrigators in a phased construction of the Shire Valley Irrigation Project scheme and providing multiple services including water supply;
 - (ii) Support farmer organization within a comprehensive land use plan; supporting land tenure strengthening and consolidation; as well as natural resources management; and
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- (iii) Establishment of smallholder owned commercial farm enterprises transitioning into commercial agriculture from subsistence farming and integrating them into commercial value chains.

These pillars all contribute to the overarching goals of the program, and build on each other in a phased approach.

This project is the first of three sequential but partially overlapping phases (with different financiers entering at different times and in parallel financing arrangements). In general terms, SVTP-I initiates the process on all pillars with a major focus on irrigation service provision to the SVIP-I area, land tenure, farmer organization and natural resource management as these precede any downstream development. While not investing heavily yet in areas of agricultural commercialization and investment promotion, it incorporates the vision and principles of agricultural modernization and commercialization and prepares for downstream investments under SVTP-II, which shifts investment focus to agricultural investment, private sector and value chain support, as well as the investments in bulk infrastructure for the SVIP-II area. Finally, SVTP-III is the scale up phase of investments to the SVIP-II area. Additionally, the government of Malawi has allocated GEF-6 resources to support investments from the Biodiversity, Climate Change, and Sustainable Forest Management focal areas. Designed as a fully blended operation, GEF funds will provide support to Component 2 (natural resources management) of the Shire Valley Transformation Project (SVTP-1). Under SVTP-I there are four components:

Component 1: Irrigation Service Provision

This component will implement the works, goods and services necessary to develop irrigation and drainage infrastructure in the SVIP-I area. This includes preparation of detailed designs and construction supervision and quality assurance, construction of the physical bulk water conveyance and main distribution system, major drainage and service and access roads. Provisions will be made for SVIP-II area in terms of canal dimensions, right of way, and preparatory studies. In parallel, the component will support spatial planning in the wider project area to ensure the irrigation scheme is well integrated with other land uses and natural resources. Subcomponent 1.2 will support the establishment of a professional management, operation and maintenance system for the scheme.

Component 2: Preparing land-based investments and natural resources management support

Sub-component 2.1 will implement the works, goods and services in support of addressing security of land tenure and organizing farmers for commercial production – as a first step in developing commercially oriented agriculture. This subcomponent supports coordinated pilot implementation of the new legal framework for land administration. Subcomponent 2.2 is GEF funded and supports natural resources management to broaden the multi-sectoral benefits of the program and enhance environmental sustainability within the modernization program. Key activities focus upon national level strengthening of frameworks for biodiversity conservation, sustainable landscape management and building capacity for field level monitoring and management of information for enforcement. The program will invest in protected areas, the Elephant Marshes and associated activities that will support improved natural resource management and the development of a broader land use plan for the Shire Valley.

Component 3: Agriculture Development and Commercialization

This component will implement the works, goods and service in support of a program of activities to support inclusive commercialization in agriculture through smallholder owned commercial farm enterprises. Financial sustainability of the SVIP irrigation investment can only be achieved through profitable agricultural production. Farms will need to be linked to Commercial Value Chains for production and sale of their produce. Development of commercial value chains will be needed to enable farmers to gain access to markets and commercial services; this is essential to enable viable commercial agriculture. The process of identifying and capacitating farmers for commercial production will begin immediately after the project is commenced so that farmers will be ready for commercial operation when the irrigation infrastructure is completed. This component will pave the way for major scale up in SVTP-II.

Component 4: Project Management and Coordination

This component will finance the multiple coordination and management needs of a project of this scale and focus on the roll out of the communications strategy and manage grievance redress mechanisms, as well as day-to-day management, monitoring and evaluation of the project. The GRMs will provide a responsive ongoing mechanism to address PAP and other stakeholder concerns raised throughout the life of the project, including those arising from resettlement and compensation initiatives, and construction and operations phases. The sub-component will finance project management structures that have been established and in place throughout project preparation. The project will provide funding for professional and support staff to strengthen the PMT and facilitate its operations, coordination and communication, including procurement, financial management, environmental and social safeguards specialists.

The major Environmental and Social impacts are associated with the construction of the Shire Valley Irrigation Project Infrastructure with the associated on-farm works and land consolidation. Construction for Phase I will commence in 2018. Phase II is expected to begin after Phase I construction completion.

Water Intake: The SVIP water intake will be at the Kapichira Reservoir, on the right bank of the Shire River. At full (Phase II) SVIP development, from 20 m³/s up to a maximum of 50 m³/s will be abstracted through the use of gravity (no pumping). The vicinity of the SVIP Feeder Canal intake in the Kapichira reservoir will require some periodic dredging. During operation, the 12 gates will be fully automated, and divided into two partitions. These will be opened and closed as needed, based on the water demands of the system.

Canals: The SVIP irrigation system will be comprised of 3 Main Canals, namely the Feeder Canal (Main Canal 1), the Supuni Canal (Main Canal 3, previously known as Illovo Canal), and the Bangula Canal (Main Canal 2, to be built during SVIP Phase II). The rest of the irrigation system will be composed of branch canals, complemented with siphons and culverts. It is expected that about half of the Feeder Canal portion that runs through the Majete Wildlife Reserve (MWR) will be buried, due to topographic considerations and to reduce drowning risks to wildlife.

All SVIP canals will be gravity-fed, with water going from the Feeder Canal into the Supuni and Bangula Canals. Main canals will be supplied on a 24 hour basis, while branch canals are likely to be used on a 12 hour basis using night storages, following furrow irrigation requirements.

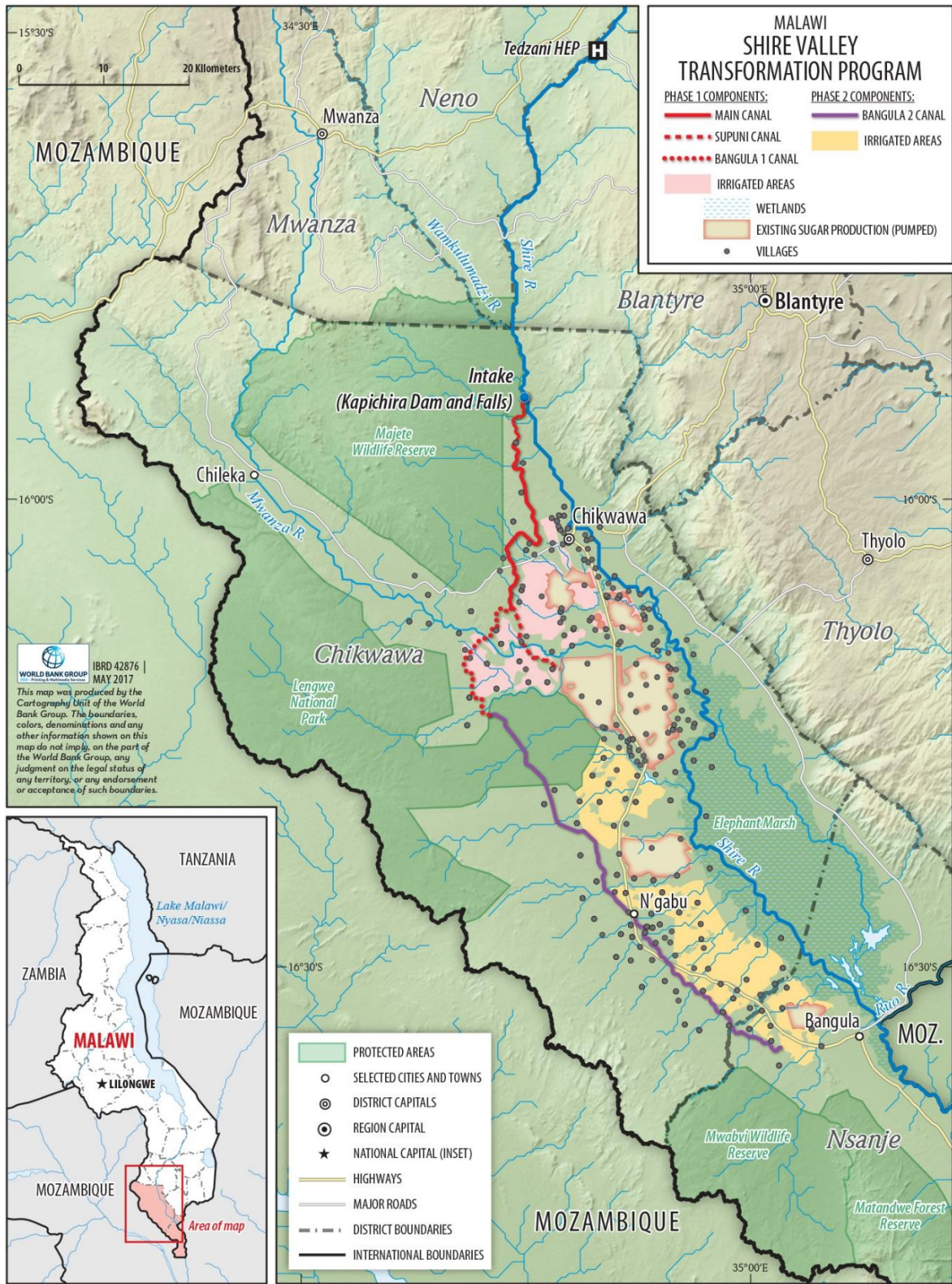
Command Areas: During Phase I, three zones of between 5,199ha and 11,250ha will be implemented. Under Phase II, an additional net area of about 21,000 hectares is expected to be irrigated. The total irrigation area that can be commanded under SVIP Phase I by this infrastructure is about 26,080 ha (gross) and 22,280 ha (net). The latter will include up to 11,535 ha of newly irrigated areas, while the remaining 10,745 ha area will involve upgrading existing pump irrigation (by Illovo and other commercial sugar growers, including outgrowers) to gravity-fed. On the newly-irrigated lands, the SVIP scheme will serve a number of commercial farm blocks, where on-farm development will be part of the farm development cost. On-farm irrigation will use a range of methods. The main irrigation method expected to be used will be furrow irrigation, but farmer organisations will be able to develop sprinkler or drip irrigation if they so choose. All command areas will include irrigated land as well as infrastructure such as access roads. Each command area will include parcels (to cultivate), drainage channels and farm roads, with construction requiring significant earthworks and land levelling.

3. PROJECT AREA: PHYSICAL ENVIRONMENT

Climate: The climate of the project area is tropical, marked by high temperatures and two distinct seasons; a rainy season from November to April, and a dry season from May to October. Temperatures range from a minimum average of 15°C in June and July to a maximum average of 35°C in October and November. Humidity ranges between 50% to 80% throughout the year, and average sunlight between 7 and 9 hours a day. There is an effective rainfall of 52%, and the region is qualified as semi-arid.

Local topography: The SVTP-I project SVIP irrigation infrastructure will be located in the Lower Shire Valley of Malawi. Map 1 shows the layout of the Main Canals, existing and new irrigated areas for Phases I and II, existing protected areas, Elephant Marsh, and other features of the Lower Shire Valley. The area starts with the ESCOM reservoir just above Kapichira Falls at 144 masl. From there, the Shire River flows mostly via the dam spillway and to a lesser extent via Kapichira Falls, down into the Lower Shire Valley, which includes a large wetland known as the Elephant Marsh. At the north of the project area, the Majete Wildlife Reserve is bordered by hills (780 masl) and the Majete escarpment to the northwest where the Mwanza River flows down. The left bank of the Shire is flanked by the Thyolo escarpment (1,500 masl) from where numerous tributaries flow.

3. Project area: physical environment



River Geomorphology: The project area includes a portion of the lower Shire catchment from Kapichira reservoir to the end of Elephant Marsh. There are two main sections to consider: a 20km section from Kapichira to Chikwawa where the river cuts through alluvial terraces; in this section, the river is fed by tributaries from the Majete and Thyolo Escarpments. The second section runs for about 100km through an alluvial plain, and receives a number of tributaries, including perennial rivers (e.g. Mwanza and Ruo Rivers), from Thambani Hills, Salambidwe Hill, the Marangwe Range, the Matundwe Range, Thyolo Escarpment and Mulanje Mountain.

The Lower Shire River is known for its high mobility throughout the alluvial plain, with its drainage area covers 11 470 km²; overall, 16 of the 27 tributaries are left-bank, and generally smaller than right-bank tributaries, except for Ruo River which is a large tributary. The Lower Shire itself has an average slope of 1‰, whilst its tributaries have a more marked slope (e.g. 7‰ for Mwanza River), which accelerates runoff.

River Hydrology: The Shire River is regulated by the naturally fluctuating water levels in Lake Malawi, as well as by the Kamuzu Barrage, which is at Liwonde, well upstream of the SVIP project area. The average flow of the Shire River at Kapichira Dam is 395 m³/s; the hydrological year is marked by two peaks, one in January, one in May, with the latter being more pronounced in dry years.

The Lower Shire Valley, notably Chikwawa and Nsanje districts, are prone to floods due to increased inflows from both the Shire and Ruo Rivers during the rainy season. At such times, the Ruo River forces the Shire back at their confluence, often causing breaching of the embankment. In addition, increased erosion upstream due to deforestation has led to higher sedimentation, which intensifies the flood threat.

Though climate models show little change to the Shire Basin flow and runoff due to climate change, the region is still at risk of a more extreme cycling between floods and droughts.

Soil, Erosion, Sediment Transport and Geology: Erosion in the catchment is an important and well-documented issue. Material transported by the Shire River, mainly originating from the West and North-West hills, is deposited in the centre of the valley. Due to increased human activity, there is increased runoff and erosion. In the top part of the basin, the deposits are mainly stratified sandy and silty alluvium. Salinity and alkalinity is reported in depressions, clay-like soils, and around marshes. Vertisols dominate the centre of the study area, with some areas being characterised by heavy Vertisols. Finally, there is little information available for the lower reaches of the area, though it seems to be dominated by a mix of Luvisols, Cambisols and Fluvisols.

Aquifer and groundwater: Previous studies have noted that groundwater in the area qualifies as brackish (91%) or salty (5%), with salinity increasing as it flows towards the Shire. The Shire River therefore does not significantly affect the water table, with water moving slowly from the river to the aquifer.

4. SOCIOECONOMIC BASELINE

The proposed project will affect up to 100,000 small holder farms from two districts, Chikwawa and Nsanje, who should benefit from the installation of gravity irrigation. Crops intended to be grown include a range of commercially grown commodity crops depending on market demand, including sugar, maize, cotton, and high value crops like tomatoes, onions, beans and sweet potato. The ESIA socioeconomic baseline used primary data (e.g. focus discussion groups) as well as secondary sources (e.g. Government of Malawi and NGO reports).

Public Consultations: the Consultant has carried out several public consultations, onsite meetings and workshops, including:

- Inception Mission (June 2015) with an inception Workshop in Lilongwe with the Task Force;
- Baseline Mission (January 2016): Meeting with stakeholders;
- Public Consultations (June 2016): Two meetings with stakeholders: One in Chikwawa and one in Nsanje to present key findings of the baseline report and presentation of a first set of mitigation measures;

Mitigation Workshops (November 2016): Two meetings with stakeholders--one in Chikwawa and one in Nsanje--to present key findings of the ESIA. An additional presentation took place to discuss the planned mitigation measures with Lilongwe-area stakeholders, the World Bank, and Malawi Government agencies. Public perceptions of the SVTP project are generally positive. However, there is some mistrust by local people about the fulfilment of the project, as discussions to date have not led to its implementation. In addition, a number of concerns were raised, notably about the drowning hazards posed by the canal for people, wildlife and livestock, and the social fragmentation resulting from the canal building. Additional issues surrounded employment opportunity, gender and youth issues, and compensation.

Social Indicators: the 2008 Population Census estimated the population to be at 434,648 and 238,103 in Chikwawa and Nsanje districts, respectively. Survey results from the area put the average household size between 4.9 and 5.1.

There are distinct gender inequalities in agricultural work. Women are found to be most active in the small-scale farms, yet men continue to be in charge of the financial undertaking for both farm produce and livestock. In addition, men are more likely to be hired for casual labour in the surrounding Illovo sugar estates, which provide more substantial income. This is thought to be one of the reasons why women make up a larger portion of those engaged in government and NGO sponsored projects in the area. During focus groups, orphans and elderly were identified by the communities as vulnerable group. Youths between 15 and 35 years of age are viewed as marginalised due to unemployment rates, whilst female-headed households are also considered as marginalised due to the lack of property and land rights in their culture.

Within the project area, 2/3 of both males and females complete primary level schooling. However, only 10.6% of females attend secondary education, compared to 14.5% of males. The overall low attendance is mainly due to the tuition fees. Generally, school infrastructure is severely lacking, which could also account for some of the primary level dropouts, alongside underage marriage.

Settlements are concentrated around communal infrastructure such as markets, schools and water points, while communities are based around family groups, communal cultural beliefs, and language. There are over 10 ethnic groups in the project area, with Sena and Mang'anja representing the largest two. Christianity is the most represented religion.

Infrastructure: Buildings are made of locally sourced materials, such as bricks (sundried and burnt), grass, poles, and clay. The most modern buildings include other materials such as cement and corrugated iron sheets. The area is served by one main asphalted road, three secondary roads, four district roads and a number of unclassified roads, which are often impassable during the rainy season. Transport is primarily limited to push bicycles, as well as motorcycles and ox-carts. Telecommunication is covered by two mobile network companies, but is unreliable away from the main road; phone ownership does not surpass 55%.

Boreholes are the most utilised water source, followed by public taps; in some areas, boreholes are saline or brackish, and communities draw water from unprotected wells in the river beds. While safe drinking water seems to be important to communities, approximately 40% of people simply cover their water containers, while 50% use more efficient ways (e.g. boiling, chlorination, filtering). About 81% of Shire Valley households have a toilet facility.

Both Chikwawa and Nsanje are home to District hospitals, and are supported by a network of dispensaries and clinics. Common diseases include malaria, diarrhoea, schistosomiasis (bilharzia), and sexually transmitted infections (STIs). In addition, communities flagged a number of health-related issues, from shortages of medication for common ailments, to shortages of staff and bed spaces.

Only urban and larger trading centers benefit from access to electricity, as the connection to the national grid is uncommon. Most households rely on candles, kerosene lamps, and solar lanterns for lighting.. Firewood remains the most important fuel for cooking, followed by charcoal; considering the host of environmental issues resulting from deforestation, such reliance is of concern.

Land: There are four categories of land ownership in Malawi: customary, government, public and private. About two thirds of land being developed for this project is customary land. Land ownership is a contentious issue in the project area, as a result of land grabbing practices, lack of title deeds, and differing customs (i.e. matrilineal vs patrilineal).

Landholding size is predominately small, with over two thirds of surveyed farmers with 0.5 ha or less. About 80% of the workforce relies on rain-fed agriculture, with crops such as maize, rice and sorghum. The second main land use is irrigated agriculture, through larger schemes such as Nchalo Sugar Estate. A few smaller, government-funded or independent schemes (e.g. treadle pump) exist on either side of the river, with rice being the main crop, sometimes alternating with maize.

This area has one of the highest livestock populations of Malawi, with 12% of farms owning livestock. Animals are kept free-range on communal land, with little additional feeding; manure is rarely used as fertilizer. Keeping the animals on communal land gives rise to a number of conflicts, especially when harvest is near.

Economics: Most households rely on agriculture, primarily maize. Overreliance on agriculture causes economic distress from November through to February, as food reserves grow low, and crops are not yet ready for harvesting. The two main cash crops are cotton, grown by smallholder, and sugar cane, grown by the Illovo sugar estates. Other key economic activities include livestock farming, which mainly happens near trading centers, and fishing. Fishing is mainly carried out by riverine households, and helps to supplement income in poor crop years.

Additionally, the main employer of the area is Illovo and is a large income contributor to many households. More than half of the population indicated an annual income of less than \$150 per year, with about 85% living on less than one dollar a day. However, through the development of Majete Wildlife Reserve, and its inclusive management style, the surrounding communities have benefited from growing tourism as well as from training events, income generating activities, and community infrastructure.

Health issues: The leading health issues of Malawi are present in the region: Malaria, schistosomiasis, soil-transmitted helminthiasis, onchocerciasis, cholera, and leptospirosis. In addition, the HIV infection is high; in the Chikwawa district alone, up to 11.4% of pregnant women were reported to be affected.

5. CULTURAL HERITAGE

The Lower Shire Valley is known for its cultural richness. on Nevertheless, the area is rich in pottery and stone tools thought to date from the Iron Age. Later, the area was known as the Lundu Kingdom, and as such, contains a number of spiritual and religious sites, such as Mbewe ya Mitengo, Mawira and Mangalangala. More recent sites of cultural significance include the Livingstone Baobab tree inside the Majete Wildlife Reserve.

The ESIA preparation included a systematic survey of the Main Canal right-of-way and other planned civil works sites, checking for archaeological relics, fossils, human graves, shrines, sacred trees or groves, and other physical cultural resources. Based on this survey, the ESMP specifies six sites of archaeological interest where pre-construction salvage of pottery fragments and other items will need to take place, led by Malawi's Department of Antiquities. The ESMP also specifies Chance Finds Procedures for civil works contractors to follow during irrigation canal construction, along with pre-construction training and awareness for contractor personnel; these procedures will be incorporated within all relevant bidding documents and contracts. The canal alignment will be selected so as to minimize interference with physical cultural resources. No graveyards are expected to be affected by the project; however, they would be relocated under the project if this were ever needed. Items of cultural interest will be systematically catalogued and stored or displayed, in accordance with guidance to be provided by the Department of Antiquities.

6. NATURAL HABITATS AND BIODIVERSITY

Terrestrial Habitats: Most of the remaining terrestrial natural habitats within the Shire Valley occur within existing protected areas: Lengwe National Park, Majete and Mwabvi Wildlife Reserves, and Matandwe Forest Reserve. These protected areas encompass a variety of natural forest and woodland habitats, including mopane and miombo woodlands, riverine forests, and native thicket. Some of these areas (notably Lengwe and especially Majete) also support a diverse array of large mammals of conservation as well as touristic interest, including Savannah Elephant, Black Rhino, Lion, Kudu, and Nyala. Due to fencing and high human density around them, there is no movement of large mammals between Lengwe, Majete, and Mwabvi; however, Mwabvi and Matandwe remain contiguous. These protected areas are also rich in bird life, with approximately 340 resident species, 250 regular migrant species, and an additional 50-60 species as vagrants; the valley is an important wintering ground for a number of Palaearctic migrants. Matandwe Forest Reserve is home to the endemic Chapman's Pygmy Chameleon (*Rhampholeon chapmani*), considered to be the world's rarest chameleon. Overall, at least 23 terrestrial vertebrate species present in the area are listed on the IUCN Red List: 11 as Near Threatened, 5 as Vulnerable, 5 as Endangered, and 2 as Critically Endangered. Rare plant species have also been found within both Lengwe National Park and Majete Wildlife Reserve.

Outside of these protected areas, most of the land is under some type of rain-fed cultivation, with some fallow lands and remnant patches of natural vegetation; smaller wildlife still persist in some of these areas.

Aquatic Habitats: Malawi is known for its numerous waterbodies, which includes the fish biodiversity hotspot that is Lake Malawi. The Shire River, which flows from Lake Malawi is divided into three main sections: Upper, Middle and Lower Shire. The planned SVIP irrigation area is adjacent to the Lower Shire, which has similar fish fauna to the Zambezi River as they are connected. The Lower Shire is indeed physically separated from the upper stretches of the River due to Kapichira Falls, an impassable obstacle that keeps fishes from migrating upstream. As such, the fish species assemblages are different above and below the Falls. In the Lower Shire, the fish species of particular economic importance include the African Catfish (*Clarias gariepinus*) and Mozambican Tilapia (*Oreochromis mossambicus*), among others. Fisheries in the Lower Shire account for about 4.2% of total fish landings in Malawi; as they are poorly regulated, such fisheries threaten to degrade this aquatic ecosystem. The elephant marshes are an important aquatic habitat for birds, fishes and herpetofauna (see below).

Elephant Marsh: Downstream from Kapichira falls, past the Mwanza River, the Shire River's floodplain expands into the Elephant Marsh, an extensive freshwater wetland. The entire Elephant Marsh encompasses over 78,000 ha, but the extent of the flooded area fluctuates considerably in response to seasonal flow changes in the Shire and Ruo rivers--in very dry years, the Marsh shrinks to as little as 20,000 ha. The Shire is responsible for at least 75% of the inflow into the Elephant Marsh; the other main water source for the Marsh is the Ruo River.

While it no longer harbors any elephants, the Elephant Marsh still holds sizable populations of Hippopotamus and Nile Crocodile. This wetland is an important habitat for numerous species of aquatic birds and other biodiversity (amphibians, reptiles, fish). Moreover, its fisheries provide a livelihood for thousands of local residents. Despite the impacts from agricultural encroachment, invasive plants such as Water Hyacinth, and human-wildlife conflicts (mainly with hippos and crocodiles), the Elephant Marsh remains a highly productive aquatic ecosystem. However, the entire Elephant Marsh currently lacks formal legal protection. Human uses are now mostly unregulated, with significant overfishing and, in the drier portions of the Marsh, replacement of much of the natural vegetation with flood-recession agriculture. However, the Natural Resources Management Component of the SVTP-I Project is expected to enhance the conservation of the Elephant Marsh through support for its designation as a Ramsar Wetland of International Importance. Furthermore, this SVTP-I component will support the establishment of Malawi's first Community Wetland Conservation Area under the administration of the Department of National Parks and Wildlife (DNPW).

7. PROTECTED AREAS

Majete Wildlife Reserve: This Reserve covers 77,754 ha and was first established in 1955. Since 2003, African Parks, an international conservation NGO, has had a concession from Malawi's Department of National Parks and Wildlife (DNPW) to manage the Majete Wildlife Reserve. Majete harbors diverse and abundant wildlife and has thus become the main tourist attraction in the Lower Shire Valley. The number of tourists has dramatically increased from just 10 in 2003 to 7,300 in 2015.

Lengwe National Park: Established as a game reserve in 1928, Lengwe was later declared a National Park and extended in 1970 and 1975, respectively. Currently covering an area of 77,587 ha, it receives less than 600 visitors a year. Tourism is restricted to the eastern section of the park, known as Old Lengwe. The most recent management plan was produced by the Shire Basin Management Program, and outlines new objectives, notably to rehabilitate LNP for wildlife, communities and tourism. The SVTP-I Natural Resources Management Component is expected to invest considerable resources in improving the protection and management of the New Lengwe portion of the Park—an area that provides critical watershed protections for the lower Shire floodplains.

Mwabvi Wildlife Reserve: This 33,193 ha protected area is managed by the same staff as the Lengwe National Park. The reserve is crossed by the seasonal Thangadzi River, and punctuated by a number of small hills. Neither the Mwabvi Wildlife Reserve nor the Matandwe Forest Reserve will be directly affected by SVIP irrigation infrastructure. However, both of these conservation areas are expected to be strengthened in their protection and management through the SVTP-I Natural Resources Management Component.

Matandwe Forest Reserve: This 28,915 ha reserve is the southernmost of Malawi's Shire Valley protected areas. The contiguous Mwabvi and Matandwe protected areas together conserve the largest remaining block of woodlands and forests in the Shire Valley.

8. POLICY AND LEGAL FRAMEWORK

The SVTP-I Project is subject to the national policy framework in support of agriculture, irrigation and sustainable natural resources management. This includes the National Constitution of the Republic, the National Road Map Malawi Vision 2020, the Umbrella National Development Planning instrument, the National Growth and Development Strategy (MGDS), and various sectorial policies in agriculture, land, forestry, irrigation, and environment. There are also various strategies to implement international conventions on biodiversity, sustainable development, climate change, desertification etc. Most of these national policies have recently been reviewed, revised, and/or harmonized.

Since SVTP-I is to be funded by the World Bank and African Development Bank, the environmental and social safeguard policies of these institutions will need to be followed. World Bank Safeguard Policies that apply to this project are Environmental Assessment OP 4.01, Natural Habitats OP 4.04, Forests OP 4.36, Pest Management OP 4.09, Physical Cultural Resources OP 4.11, Involuntary Resettlement OP 4.12, Safety of Dams OP 4.37, Projects on International Waterways OP 7.50.

According to Malawi's Environment Management Act of 1996, the SVTP-I Project requires an Environmental Impact Assessment under multiple criteria. Also, since the project involves work in protected areas, it falls under the National Parks and Wildlife Act of 1992. This project is also subject to the approval of Malawi's Technical Committee on the Environment, a high-level group of representatives from multiple ministries and agencies.

9. PROJECT IMPACTS AND MITIGATION MEASURES

Impacts arising from the Project have been assessed using four criteria, namely, the affected component's value; impact intensity; impact extent; and impact duration. Simultaneously, the probability of impact has been assessed. Altogether, impacts identified with 'major impacts' require mitigation, offsets or compensation (followed by monitoring), whilst 'minor impacts' seldom necessitate more than mitigation.

9.1 IMPACTS DURING PRE-CONSTRUCTION PHASE

The overall impacts during the pre-construction phase are concentrated in community organisation and the natural heritage front. These include community reorganisation and resettlement, which will be addressed in the Resettlement Action Plan. In addition, the final decisions on canal design and alignment was influenced by the type of long-term consequences on the National Parks. Finally, the use of a tendering process for construction will need to be inclusive and closely monitored in order to ensure the adherence to the environmental mitigation recommendations determined in the ESIA and its ESMP. On the other hand, there will be no impacts on the physical environment or ecology during the pre-construction phase.

9.2 IMPACTS DURING CONSTRUCTION PHASE

The following is a summary of impacts during construction phase. The ESMP provide further details on the role of the each actors in the implementation of mitigation measures and monitoring of impacts.

Impacts from the tender process for a construction contractor: The selection of a construction contractor and the inclusion of appropriate mitigation measures in call for tender and contract is a crucial step as many contractors are not environmentally and/or socially proactive and most have no experience in working in sensitive areas.

Mitigation:

- The selection of the construction contractor will require a conscious decision by project proponent and financing agencies prior to tendering. The bidding document and contract shall reflect the new requirements of the World Bank as highlighted in the document “Summary of Environmental, Social, Health and Safety (ESHS) Enhancements Standard Procurement Documents (SPDs) & Standard Bidding Documents (SBDs)”;
- African Parks and the DNPW should have a right to review the Design for the upcoming Phase I and to propose improvements, as Phase I will soon start. African Parks and the DNPW shall also be involved in the pre-qualification selection of the construction contractor as advisors;
- In addition, many measures proposed in the ESIA and ESMP involve costs for the construction contractor, call for tender shall be clear on the requirement to quantify measures in the Bills of Quantities;
- Contractors will be required to prepare and submit their Construction ESMP (CESMP) to the PIU for approval prior to commencing any civil works. The CESMP will be based on the updated ESMP that takes into account the detailed engineering design. It will also include management measures for borrow pits, quarry areas, disposal sites, construction camps, etc.
- It is highly recommended to require that the contractor has experience working in wildlife parks but most importantly, its reputation must be assessed by a Tender panel.

Impacts on river geomorphology and water quality: The construction of the irrigation system will require extensive construction work around existing rivers, and as such will affect the geomorphology of rivers, as well as the water quality.

Mitigation:

- In order to minimise impacts, the mobile nature of the rivers shall be taken into account;
- Crossing of tributaries shall be done in straight lines;
- A buffer zone will be maintained around river so that irrigated fields are not too close to river banks;
- Infrastructure to solidify banks shall be installed (e.g. gabions).

Soil excavation and land levelling: the project will require extensive excavation work for canals, as well as rock blasting.

Mitigation:

- All reusable excavated soil shall be either provided free of charge to surrounding communities, or flattened and revegetated;
- Burrow pits from blasting should be repurposed whenever possible and in consultation with communities (e.g. creation of wetland, filled with unusable soil, etc.).

Impacts on workforce: The construction site will offer a number of job opportunities for the local populace, both skilled and unskilled.

Enhancement and mitigation measures:

- There will be a need to prioritise local workers in order to revitalise the local economy, and actions will be necessary to minimize the negative impacts which could result from the influx of foreign workers (e.g. increased human pressure on natural resources, gender based violence, etc.);
- These actions are the enforcement of a workers code of conduct, the development of a grievance redress mechanism encompassing the construction phase to allow community to communicate with the construction contractor about their concerns and grievances (and behaviour of workers), and the fight against encroachment in Lengwe National Park and Mwabvi Wildlife Reserve;
- The Contractor will also be required to prepare and submit to the PMT for approval a Labor Influx Management Plan prior to commencing any civil works;
- To minimize the risk of sexual harassment and gender based violence due to the influx of male workers in the Project area, it will be important to mobilize and reinforce the presence of the local law enforcement in the area.

Impacts on infrastructure agriculture and cultural heritage: The project will have manifold impacts on the human infrastructure, natural and cultural heritage throughout its construction.

Mitigation:

- Chance Finds Procedures for the civil works contractors to follow during irrigation canal construction, along with pre-construction training and awareness for contractor personnel are to be incorporated within all relevant bidding documents and contracts;
- The canal alignment is being selected with a view toward minimising interference with physical cultural resources. No graveyards or shrines are expected to be affected by the project;
- Items of cultural interest will be systematically catalogued and stored or displayed, in accordance with guidance to be provided by the Department of Antiquities;
- In addition, new infrastructure accompanying the construction (e.g. bridges) should be developed simultaneously in order to limit disruptions, health and safety risks, and facilitate reprise of activities by local communities. The ESMP has recommended that one cattle/pedestrian bridge be built every km of main canal.

Impacts wildlife parks and reserves: Considering the passage of canals through Majete Natural Reserve (during Phase I) and Lengwe National Park (during Phase II), the impacts during construction in these areas are non-negligible. Infrastructure and fences will be impacted during construction, as well as tourism due to the noise, earth work and machine and truck traffic.

Mitigation:

- In order to minimise the impacts, it is crucial that park/reserve managers work hand in hand with construction and that all parties agree and respect schedules and mitigation measures (e.g. fencing off areas, road diversion, right of way, etc.);
 - In order to mitigation impact, it is absolutely necessary to include appropriate wording and all applicable mitigation measures in the call for tender (and terms of references) and in the contract of the construction contractor including leverages such as non-payment for non-compliance and on-site audit by a Supervising engineer;
 - Certified noise barriers will have to be installed in MWR as work will take place very close to all important building and touristic sites;
 - There will be a need to phase and confine the work into distinct areas inside MWR, in order minimize disruptions. The scheduling of these should be made clear within the construction tender. The ESMP has describe three phases for construction which distinguishes the area along the Shire inside MWR, Ng'ona lodge private property and the Southern tip of MWR;
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- For inevitable impacts such as loss of revenue and infrastructure destruction, a compensation schedule shall be drawn up based on the ESMP.

Impacts on terrestrial biome: there are two major considerations to investigate, notably the rapid change in land cover and the disruption to wildlife and vegetation. The construction will inevitably modify the current vegetative landscape, though much land area is already converted agricultural lands.

Mitigation:

- A reforestation scheme in LNP and MWR: in MWR, 25 ha of forest will have to be compensated and in LNP 60 ha of forest and thicket;
- Setting aside lands for protection concern, i.e. Open woodland (including riparian forest), Marshes and flood prone area, Heavy Vertisols area, Grazing area, Rivers and their banks, wetland and buffer zones around LNP. This will require that the Design study fine tunes the irrigated areas to create set-aside lands and access for cattle to grazing sites along the Elephant marsh;
- Carefully designed and implemented safeguarding plans for protected trees and avoiding communal forests.

Impacts on aquatic habitats: Construction will lead to work on intermittent rivers, which a number of fish use to migrate to spawning sites.

Mitigation:

- In order to limit unforeseen damage to these channels, temporary earth dikes and other structures that can modify the channel or destabilise earth banks should be avoided;
- The ESIA recommends that channelization of some rivers be avoided or done in consultation with stakeholders to minimize impacts (for example: Nkombedzi Wa Fodya River which crosses LNP) ;
- In addition, appropriately placed and sized culverts should be provided in order to ensure that there are no floods (super-sized culverts with natural bottoms), and work prohibited on these channels during fish spawning season.

9.3 IMPACTS DURING OPERATIONAL PHASE

The following is a summary of impact during operation phase. The ESMP provide further details on the role of the each actors, mainly the Bulk Water Operator, in the implementation of mitigation measures and monitoring of impacts.

Hydrological impacts: During operation of SVIP, canal capacity will be 50m³/s (at peak), and this amount will be abstracted from the Shire system at Kapichira reservoir. This is a consumptive demand at that location as this amount will not be released directly back in the system (about half will be released back to drains and to the water table). This will lead to modest environmental impacts on Elephant Marsh and minor impacts on tourism at Kapichira Falls, which will have reduced water flow in the dry season until the tailrace of the powerstation, which may render the falls invisible for a larger part of the year.

Mitigation:

- The Project will support the development of operational rules for Kapichira Reservoir between EGENCO and the scheme operator under MoAIWD, based on monitoring during project duration. To inform the operating rules, the project will support monitoring of the actual flows over the fall during SVTP-I before canal operation starts, under the auspices of both EGENCO and MoAIWD to have better reference of the flow situation over the falls in the wet and dry season as well as localized biodiversity, and to include consideration for safeguarding minimum environmental releases as determined necessary over the spillway for adoption when operation commences for Phase I, to be updated in SVTP-II prior to construction of Phase II. The project will also carry out continued monitoring of environmental status of Elephant Marshes under the NRM component.

Cumulative impacts of increased water use and climate change: This has been area of attention for the Government for the past 6 years and the Government is implementing the long term Shire River Basin Management Program (SRBMP). This is a long-term program with the objective of increasing sustainable social, economic and environmental benefits by effectively and collaboratively planning, developing, and managing the Shire River Basin's natural resources. As such, the SRBMP is the Government of Malawi's chief tool for managing the cumulative impacts of multiple investments within the Shire River Basin, as well as the multiple demands upon the Shire River's water resources. Since its inception in 2012, the SRBMP has (i) supported inter-sectoral development planning and coordination mechanisms; (ii) undertaken high-priority water-related infrastructure investments; and (iii) developed up-scalable systems and methods to rehabilitate sub-catchments and protect existing natural forests, wetlands, and biodiversity. This approach seeks to provide a balance between building capacity for strategic planning and on-the-ground investments to address immediate needs. The SRBMP has thus made a promising start towards addressing many of the most critical issues facing the Shire Basin. Future phases of SRBMP will seek to scale-up and broaden existing activities, based on the lessons learned from implementation of the current first phase. The SRBMP is intended to serve as an integrating framework to synergize the work of all key institutions in the Basin. Shire Basin Planning has incorporated sector plans and features SVTP in its planning, along with climate scenarios. The Plan prioritizes sector and multi-sector actions and addresses the emerging environmental and social issues associated with the prioritized investment options, along with the management strategies for how to address them. The Shire Valley Irrigation Project ranks high on the list of recommended priority investments and is considered sustainable abstraction within the basin's available water resources.

Hydraulic transparency: Due to the dynamic nature of this riverine landscape, poorly designed culverts and other infrastructure could lead to damming of tributary rivers and flooding of villages upstream. Any floods inside main canals could also lead to colonisation of Lower Shire fish species upstream of Kapichira falls.

Mitigation:

- In order to avoid such occurrences, the culverts sizes should adhere strictly to the designs that are informed by highest flow data (super-sized culverts).

Water Quality: Drainage water quality can carry nutrients and pesticides and silt back to the river. This is likely to occur and will have impacts on water quality downstream. Mitigation measures are careful environmental monitoring, promotion of IPM (see Pest Management Plan) and technical assistance on efficient application of water and fertilizer. Incorporate activities to limit erosion.

Changes in soil properties: Irrigated agriculture sometimes trigger a series of changes in soil properties; salinization, sodicity, waterlogging.

Mitigation:

- Monitoring of soil properties is highly recommended. Soil water levels and salinity will require very close monitoring to provide early warning of problems;
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- In addition, due to the presence of poorly drained Vertisols in two of the three canal zones (B and C), alternative crops such as rice should be considered or these areas can be considered for environmental set-asides.

Rapid social change and hinterland effect: The installation of a modern irrigation scheme will necessitate the social acceptance and behaviour modifications from local communities in order to truly be successful. Furthermore, increased economic and demographic growth in the area could increase pressure on natural resources, including on water, wood and fish. The community level communication is currently addressed in the communication strategy, while the latter is to be addressed by other stakeholders as the project evolves.

Lack of proper maintenance of infrastructure: This ESIA requires that a number of mitigation infrastructure be installed (e.g. bridges, wildlife passes, walls) which will need to be adequately maintained in order to ensure their efficacy.

Mitigation:

- Responsibility of maintenance shall be assigned for all infrastructure. It is recommended that the Bulk Water Operator be responsible for maintenance of infrastructures proposed in the ESMP:
 - Bridges (cattle, pedestrian, and vehicle)
 - Safety stairs and ladders for villagers to bathe and wash and to exit in case of falls
 - Invasive fish barrier
 - Water intake trash rack (to hold back debris, crocodiles and floating Water Hyacinth)
 - Walls around the open canal section in MWR;
- In order to prepare for long term risks and to ensure that stakeholders interests and mainly those of parks are not affected by others, clear chain of responsibilities have to be defined taking into account all possible situations and “worst case scenarios”;
- Training should be given to users of the canal system to ensure proper use of the irrigation canals (e.g. avoid waste-dumping);
- In addition, due to the presence of water hyacinth in the Kapichira Reservoir, regular eradication plans should be continued and extended to the canal as needed. The sharing of responsibilities for these activities should also be addressed in the Reservoir Management Plans.

Changes and delays in agricultural development: Whilst the project is designed to allow further agricultural development past subsistence agriculture, delays to the start of operation and or of behavioural shift could potentially postpone benefits, especially at a household (e.g. food security) and community level (e.g. access to improved health and education facilities).

Mitigation:

- Adaptive research and development;
- Creation of best practices based on the lessons from Phase I (before starting Phase II);
- Increased market-linkages;
- Emphasis on the export industry and the food transformation industry.

Livestock rearing: Livestock rearing practices will need to be adapted to the new conditions, as canals and command areas will represent obstacles to movement of cattle and grazing lands and water points will be reduced.

Mitigation:

- In order to avoid conflicts, infrastructure will be put into place along main canals, including drinking troughs at every village and cattle bridges at each kilometre of main canal;
- In addition, conflict management structures between cattle herders and irrigation farmers shall be instated, alongside access to unfarmed land for grazing and new business opportunities (e.g. organic manure).

Decline in fisheries: Fisheries, which are already in decline, may further be affected by the decrease in flows in the Elephant Marsh.

Mitigation:

- In order to decrease the extent of this impact, fish farms are proposed, in line with the Agricultural Development Planning Strategy;
- A wetland management plan under the Shire River Basin Management Program (SRBMP) and SVTP also aims at sustainable development.

Health and Safety: The intricacy of the canal system will increase the risk of drowning and injuries, specifically for children, as they are at risk even in the shallowest channels.

Mitigation:

- Sensitisation campaigns to be implemented, notably in schools, but also the addition of safety features such as ladders at every 500 meters in main canals (Feeder, Bangula and Supuni). Large safety stairs shall be built at every villages along main canals;
- As schistosomiasis is expected to rise but not malaria (malaria prevalence is not linked with the presence of canals), farmers and canal workers will be expected to wear suitable protective clothing. In addition, sensitisation campaigns will be put in place as well as preventative treatment campaigns (e.g. praziquantel for Schistosomiasis), and construction of pit latrines.
- The ESMP also recommends to provide funds for capacity building for local health specialists to use up-to-date detection method for both urinal and intestinal schistosomiasis.

Impact on gender and vulnerable groups: The project has both the potential to benefit women through improving their access to water, as well as impacting them by increasing their workload in agricultural yield. Furthermore, as financial services often remain unattainable to women and youth, they may not have access to the same opportunities as men arising from the operation of the irrigation system. Likewise, landless people may be disadvantaged by the project.

Mitigation:

- Mitigation efforts on this aspect are fully described in the Gender and Youth Strategy Study, and are to be implemented from the preparatory phase through to operation;
- Additional mitigation will be included in the upcoming Resettlement Action Plan.

Kapichira falls attractiveness: The present project will decrease the environmental flow released by the sluice gates, known as Kapichira Falls decreasing the touristic value of this site. However, falls draw tourists in the rainy season, when irrigation needs are lower and falls should still be attractive.

Impacts in wildlife parks: The passage of the project through two wildlife parks will inevitably cause long-term changes in the park through the creation of new infrastructure, the introduction of new stakeholders (such as the bulk water operator) as well as new chains of responsibility (especially regarding maintenance of infrastructure). These changes have the potential to greatly encumber the reserves and their management's mission, and present a number of unknown risk factors, from changes in animal behaviour and drownings, to increase in encroachment and poaching. The latter are of particular concern in Lengwe National Park, which already suffers from imposing human pressures.

Mitigation:

- In order to mitigate these impacts, it is necessary that a Memorandum of Understanding be signed between African Parks/Department of National Parks and Wildlife (DNPW) and the bulk water operator for MWR, and DNPW and the bulk water operator in LNP;
- The canals shall remain part of the MWR and the right-of-way of the canal not be alienated from MWR. Access to the intake and canals for maintenance will be managed in accordance with African Parks' access restrictions (and inspection to avoid poaching);
- The presence of a canal in LNP, if designed to avoid animal drowning, could be a positive impact because this park suffers from water shortages. This might well produce a net gain from a conservation standpoint for LNP. An artificial wetland with water pumped from the main canal shall be installed in both MWR and LNP to create a drinking spot for wildlife;
- Most illegal wood cutting activities and illegal grazing originate from communities in Zone A and B; however, as they gain to benefit from the SVIP, their inclusion in the scheme shall be conditional upon a signed agreement to comply with the rules prohibiting wood cutting, grazing, or other unauthorized activities within Lengwe National Park (this also applies to MWR and surrounding communities). Village headmen shall sign a contractual agreement or some form of formal engagement to respect this rule prior to their inclusion in the scheme. The SVIP should be used as an opportunity to request some environmental engagement in exchanges of irrigation;

Habitat fragmentation: The building of canals will invariably fragment usable habitat, which will be of most relevance in MWR and LNP.

Mitigation:

- The construction of buried canal sections in MWR would reduce this issue; currently, most of the Feeder canal will be buried in MWR;
- In LNP, there are also options of creating wildlife over- or underpasses at same locations as vehicle bridges, and options are considered to create wildlife friendly crossings and drinking places.

Wildlife drowning hazards: Due to the nature of this project, there will be an inevitable risk of drowning for the numerous animal species in LNP and MWR due to the slippery nature of the concrete lined canals and the steep slope (1 Horizontal/3 Vertical) and the attractiveness of the canal as a drinking spot (especially in the dry season).

Mitigation:

- The ESIA has highlighted the need to erect a concrete and brick wall along the canal in MWR in section where the canal will be open ;
- The ESIA has highlighted the need to provide gripping material in the canal in LNP or the need to design an earth canal in LNP (earth canals offer good grip so animals can exist the canal);
- All options will represent a higher financial cost, but currently low maintenance concrete and rock walls are recommended for MWR, and a flexible matrix of cellular concrete blocks in the channel lining in LNP or an earth canal in LNP.

Changes in wetland plant communities: With a decrease in flow due to abstraction at the most critical period of the year (the dry season), there will be a decrease in suitable habitat for some wetland vegetation and a potential increase in human encroachment and dimba agriculture (recession agriculture), reducing the plant community diversity.

Mitigation:

- Under the Natural Resources Management Component 2.2, the SVTP-I Project will also enhance the conservation of the Elephant Marsh through support for its designation as a Ramsar Wetland of International Importance, and with the establishment of Malawi's first Community Wetland Conservation Area under the administration of the Department of National Parks and Wildlife (DNPW). Therefore, future agricultural encroachment within Elephant Marsh is likely to be limited;
- In addition, the 2015 flooding altered the course of the Ruo River, which now joins the Elephant Marsh directly. The ESIA recommends that this new channel be maintained to mitigate effects from the Project, though human resettlement from around the banks of the Ruo River would be advised to limit flooding risks.

Increased wildlife-human conflict: Human-wildlife conflict will be exacerbated, notably with crocodiles and hippopotamus because they will be impacted by changes in Elephant marsh.

Mitigation:

- While there are a number of mitigation efforts that can be considered based on the species being dealt with (e.g. non-food crops close to canals to avoid hippo raiding), sensitisation programs will be the main action to avoid risky behaviour;
- The Natural Resources Management Component includes investments intended to reduce human-wildlife conflicts in the Elephant Marsh

Invasion of Lower Shire fishes: Kapichira Falls constitutes a barrier between the Lower Shire to the Middle and Upper Shire. Currently, the Tiger Fish and other Zambezi River fishes are present only in the Lower Shire; the gentle slopes of the envisaged main canals could allow downstream fishes (including the Tiger fish) to by-pass Kapichira Falls. The Tiger fish has the potentiality of creating ecological havoc if it were present in the rest of the Shire basin; most notably, due to its piscivorous and aggressive nature, it has the potential to significantly alter the mainly endemic cichlid populations of Lake Malawi.

Mitigation:

- An effective fish barrier shall be put into place. Self-reliance and low maintenance are the two principles that should govern the fish barrier choice and installation. The Technical Feasibility Study recommends a high fish weir consisting of a 3.5 meter drop structure topped off with a 1 meter crest. This will result in a vertical free fall of at least 2 meters when the canal is conveying the maximum amount of water (50 m³/s) and a higher free fall with any lower water flow. This fish weir will be incorporated within the Main Canal Detailed Design, with the incremental cost included as part of the total canal construction cost. This high weir is intended to effectively prevent any entry of Tiger fish- or any other non-native fish species to Lake Malawi - into the upper Shire River above Kapichira Falls through the Main Canal. To minimise the risks from human interference (including the accidental or deliberate release of non-native fish into the canal, above the barrier), the fish weir will be located within the Majete Wildlife Reserve, where human access is carefully controlled. Also, this area is farther upstream and outside of flood prone area.
- Maintenance of the fish barriers will be the Bulk Water Operator's responsibility (this shall be highlighted in the call for tender).

Reduction of aquatic habitat quality: With a reduction of flow, Elephant Marsh will be impacted; as such, there will be a decrease of suitable habitat for fish as well as a possible decline in quality.

Mitigation:

- Much of the management and mitigation efforts for Elephant Marsh fall under the mandate of the Shire River Basin Management Programme. In addition, Natural Resources Management Component of SVTP-I includes investments in community fisheries management, intended to make fisheries in the Elephant Marsh more sustainable.
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9.4 ASSESSMENT OF ALTERNATIVES

A number of alternatives have been considered during program design, including the without-project scenarios. This section presents the assessment of alternatives to achieve the program objectives in Malawi:

- The parameters of the scheme are convincing in addressing the critical water-agriculture-nexus in Malawi and the scheme features highly in investment prioritization matrices. This is due to:
 - (i) Its unique location for agriculture. Agro-ecological potential is very high if water is brought to this area as demonstrated by existing pumped irrigation in the valley. Any intensification for commercial agriculture in Malawi requires investment in irrigation; this area suffers most from lack of precipitation making even subsistence rain fed agriculture very precarious.
 - (ii) Its impact on the water balance. When fully developed the scheme will abstract in the critical month of September about 12 percent of the long term Q80 Shire River flow for that month at Kapichira. Virtually all other irrigation in the country would be upstream and affect the entire hydropower cascade and other uses and possibly future upstream hydropower development as well, so this is a least harm alternative, and economically justified. The scheme is designed and technically limited within sustainable resource use parameters and this was confirmed in the national water resources investment strategy as well as the Shire River Basin Management Program planning where alternative sites/developments have been analyzed; and
 - (iii) Its impact on the energy balance. With Malawi's severely constrained energy situation, pump-based irrigation is unfeasible and undesirable. This scheme enables the expansion of irrigated area in the country by 40 percent, only relying on gravity, while enabling the release of power to the currently underserved national grid through converting current large scale pump based irrigation to gravity.

The technical design studies have been optimized from earlier versions that have been developed over the years, and alternatives have been considered, including options that would bypass Majete Wildlife Reserve altogether, and smaller pump-based versions. These designs would have prohibitive cost in construction and long term operation, rendering them non-viable. The current design is robust, has reduced environmental impacts by rejecting the alternative original design with an intake at Hamilton Rapids (9km upstream) and is better addressing current technology and farming models, optimizing resource utilization rather than low equilibrium agriculture. It has prioritized commercial agriculture instead of low value crops and better integrated multiple uses including livestock, drinking water and the environment. It is technically, financially and socially undesirable to "pilot" with a smaller command area as costs per hectare would dramatically increase, future expansions would be significantly compromised, and short term benefits would be skewed towards existing commercial enterprises.

Several options have been considered in the ESIA/ESMP:

- **Canal options:** Apart from the choice of route inside vs. outside Majete Wildlife Reserve (MWR) as mentioned above, several technical options within Majete have been considered to minimize impacts during construction and operation. An option was considered to bury most of the length of canal, which will not function as a barrier or trap for animal movement as an open canal would. Much of this stretch will be within a siphon which reduces the length of canal and physical footprint in the canal as compared with the alternative where the canal follows the contours. Various lining options have been considered for the open sections. Final selection for the stretch in Lengwe National Park is to be made, but there is a strong preference for a technical design option that avoids slippery slopes and allows safe access and passing of wildlife.
- **Wildlife protection within MWR:** Various work schedules have been discussed and the selected option limits disturbance to wildlife and tourism. For the open canal section alternative barriers have been considered and a masonry wall with local rocks has been selected as the most robust and most visually attractive scenario.

- **Tiger fish invasion at Lake Malawi and Shire River:** Various alternatives have been considered and discussed with technical experts. While an independent panel is to verify final design, the choice was made for the design of a fish barrier that uses a high vertical drop with proven effectiveness and very low maintenance requirements, as compared with the two alternatives: use of fish screens (which would have had less head loss but which would be very difficult to maintain in good working condition and a construction with a lower drop and screen, which was considered less desirable.
- **Environmental flows:** Various scheme sizes, cropping patterns, scenarios with/without Illovo estate have been considered; and alternatives were considered for expanding hydropower rather than irrigation, and other developments and climate change scenarios were incorporated in this multi-criteria analysis under the Shire river Basin Program.

A without project scenario would perpetuate the unsustainable livelihood scenario and poverty levels in the lower Shire, with long term negative impacts on household food security, natural resource utilization, and would not provide much needed economic impetus in the Shire Valley and beyond. From a safeguards perspective certain potential impacts associated with canal infrastructure and intensive agriculture would be avoided, but also opportunities for addressing these and other challenges in an integrated landscape approach would not be seized. On balance, with robust mitigation measures in place, it is anticipated that the program can deliver net social and environmental benefits over the baseline scenario. It is a safe assumption that without the project, continuous unregulated use and exploitation of the marsh will continue that will contribute to its degradation in the long run. Majete WR might not be negatively impacted most likely as it is managed well, but the other reserves and natural habitats might continue to be degraded and lose biodiversity.

10. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

In order to address the identified potential adverse environmental and social impacts the second volume of the ESIA contains the ESMP. Thus, the ESMP proposes ways to ensure that measures are operational. It provides cost estimates, schedule and describes the chain of responsibilities for each mitigation and monitoring action. The ESMP is presented in Action Plans. A major focus of the ESMP is the Detailed Design study as many measures require attention during design and construction of civil works. The ESMP focuses on the impacts associated with the first phase Project. Works under Phase II will not start until there is an approved ESMP for that Phase, independent of who the financiers are, and the ESMP for Phase I will be updated once detailed designs are ready. The ESMP also provides for screening methodology and forms for screening environmental impacts of smaller livelihood based activities and sub-projects for which the scope is not yet determined.

Mitigation / compensation	Cost for mitigation / compensation in USD
Compensation Plan for Majete Wildlife Reserve	One year construction period in MWR 1,351,830 (best case scenario no loss of business revenue) to 1,961,830 (worst case scenario no business revenue)
	Two year construction period in MWR 1,370,990 (best case scenario no loss of business revenue) to 2,610,990 (worst case scenario no business revenue)
Action Plan for the potentially invasive fishes	Costs are presented in the Feasibility study*
Cost of Action Plan for health and safety	169,000
Cost of Action Plan for socioeconomic impacts (including cattle bridge, footpath and vehicle bridge) and cultural heritage Plan	4,063,280
Total cost (excluding the fish barrier) **	From 5,584,110 to 6,843,270

* Cost for the invasive fish barrier inside MWR, as estimated by KRC (2017) is 4.3 million USD, since this subject is a going debate, only the Detailed Design study will enable to provide a final cost on this barrier. The amount is therefore not taken into account in the ESMP costing.

** The total cost also excludes costs to implement measures to address construction-related impacts that will be spelled out in detail in the Construction Environmental and Social Management Plan (CESMP) that will be prepared by the contractors as specified in bidding documents. The costs will be part of the contract costs and will be reflected in the bill of quantities. The costs for the Pest Management Plan (PMP) are provided in detail in that plan.

The ESMP shall be read in conjunction with the other measures proposes in other technical studies taking part of SVIP. Although the Project leads to uncommon impacts, with commitments, funds and reliable mitigations, it could become an example for future irrigation schemes in sensitive areas.

11. PEST MANAGEMENT PLAN

Pesticides uses: As presented in the Pest Management Plan, development of the SVIP will lead to increase use of pesticides. Pesticides can impact water quality, biodiversity and human health. The risks of such impacts are heightened with improper pesticide use and disposal. The PMP has described an Integrated Pest Management (IPM), with clear responsibilities and associated budgets, aiming at:

- Sustainable control of pests in sugarcane plantation ;
- Sustainable control of weeds in sugarcane plantation;
- Sustainable control of diseases in sugarcane plantation;
- Management of post-harvest pests of cereal crops;
- Sustainable control of pest for other crops;

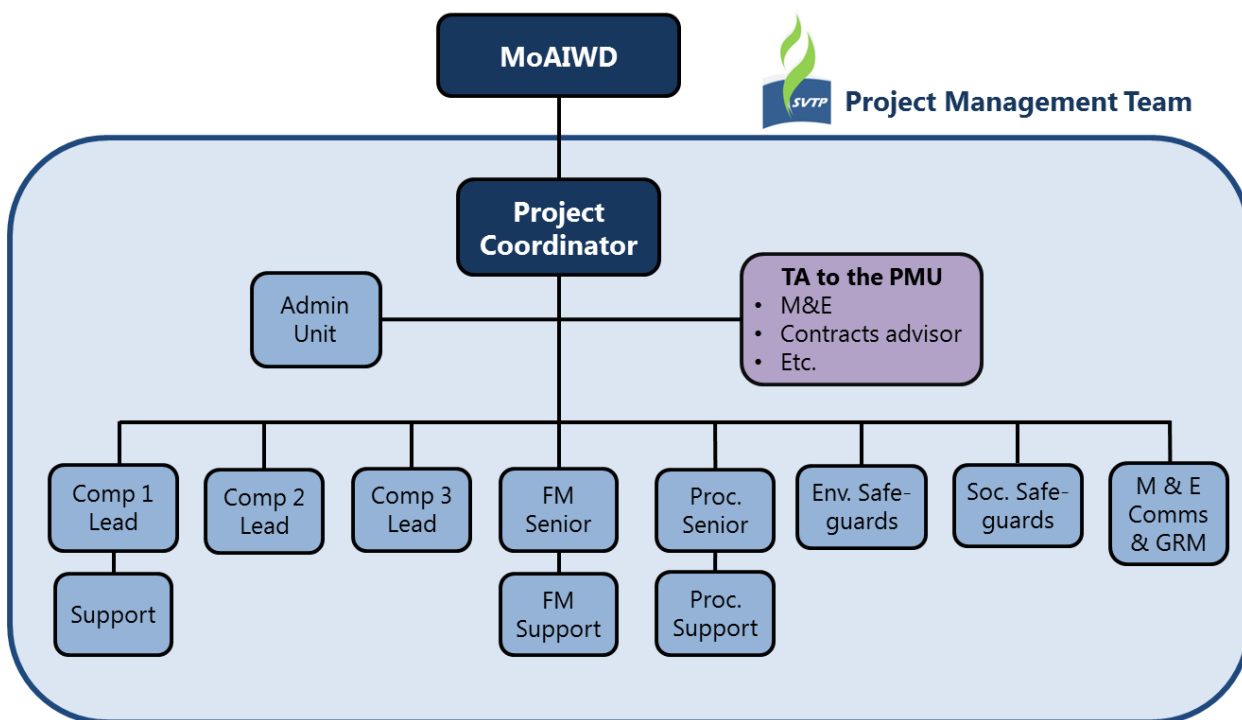
The measures developed in the IPM fall in the following categories:

- Pesticide application and disposal of pesticide containers (including incinerator, registration of pesticides, etc.);
 - A list of recommended selective pesticides;
 - Safety management principle and best practices for environmental and human safety;
 - IPM capacity building for farmers (workshops, training session, etc.);
 - IPM monitoring;
 - Development of an IPM implementation team.
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12. INSTITUTIONAL RESPONSIBILITIES FOR ESIA MONITORING AND ESMP IMPLEMENTATION

The ESIA identifies the institutional needs to ensure the effective implementation of the social and environmental management and monitoring program as outlined in the ESIA and ESMP so that the Project's benefits are maximised and that the Project is implemented on a sustainable basis. It is important that the institutional arrangement provides the capacity to implement social management plans. Recommendations are also included for staff on environmental monitoring and management aspects. The ESMP is based on MoAIWD having the overall responsibility for the coordination, planning and implementation of the Project as well as the actual implementation of the environmental monitoring and management and land acquisition and resettlement components. It is also based on the appointment of a construction Supervision (Management) Consultant with responsibilities under the direction of MoAIWD of directly supervising the Contractors implementing the works.

The Program will have a steering and technical committee at national level, a consultative committee and a technical team at local level. The Project Management Team (PMT) comprises of civil servants and recruited professionals for project management, coordination and monitoring. All project operational modalities are detailed in the Project Implementation Manual, with gantt charts, flow charts, responsibilities. A component Lead will be responsible for comprehensive management, liaison and coordination of the respective pillar, under the guidance of the project coordinator. The safeguards coordinators will lead all implementation, monitoring and compliance documentation of the safeguards instruments and will liaise frequently with the service providers on issues related to safeguards, health and safety, etc. The same applies to the M&E, Communications and GRM officer, who will be responsible for maintaining the project Management Information System, lead communications and manage the Grievance Redress Mechanism with relevant committees.



The responsible Implementing Agency, here the Ministry of Agriculture, Irrigation and Water Development has the overall responsibility for coordinating and monitoring implementation of the ESIA recommendations, as well as its required updates. SVTP works through representatives of key government ministries and stakeholders under a taskforce governed by a joint MoU.

The Environmental Affairs Department, coordinates and facilitates sustainable management of the environment and natural resources in Malawi. As such it is responsible for harmonization of national environmental policies and legislation, enforcement of legislation, capacity building, and compliance monitoring. The Director of Environmental Affairs may arrange for public consultations as part of the EIA process, in order to sensitise the communities and to create awareness. The TCE may require to carry out their own site and works assessment before making the appropriate recommendations to the National Council on the Environment (NCE), through the Director of Environmental Affairs (DEA). The NCE will evaluate the recommendations of the TCE and make appropriate recommendations for approval.

The Department of National Parks and Wildlife is mandated to protect and conserve wildlife in protected areas such as National Parks and Wildlife Reserves in collaboration with other stakeholders especially boarder zone communities. It has concessionaires in some parks, notably in Majete Wildlife Reserve while maintaining overall responsibility.

The ESMP provides action plans and implementation schedules for the monitoring and mitigation measures. This schedule will be reviewed and revised at least every 6 months during the construction period and on an annual basis for other activities.