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REPUBLIC OF MALAWI

MINISTRY OF AGRICULTURE, IRRIGATION AND WATER DEVELOPMENT

SHIRE RIVER BASIN MANAGEMENT PROJECT

DRAFT ENVIRONMENTAL AND SOCIAL ASSESSMENT (ESA) AND ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK (ESMF)

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EXECUTIVE SUMMARY

This Draft Environmental and Social Assessment with Environmental and Social Management Framework (ESA+ESMF) has been prepared for the Shire River Basin Management Project, which the Government of the Republic of Malawi will be implementing through the Ministry of Agriculture, Irrigation and Water Development. The purpose of this ESA and ESMF is to guide the integration of environmental and social considerations in the planning and implementation of the SRBMP activities.

The Government of Malawi has received a Project Preparation Advance (PPA) on the proceeds of a credit from the International Development Association (IDA) of the World Bank, to finance the preparation of the SRBMP. The World Bank plans to assist the Government of Malawi with the financing of this Project, as part of a longer term Program (12-15 years – for which the SRBMP is the first phase of about 5.5 years).

The overall Program development objective is to make significant progress in achieving socially, environmentally and economically sustainable development in the Shire River Basin. The Project development objective is to (i) prepare a strategic planning and development framework for the entire Shire River Basin (defined from outflow of Lake Malawi to the border at Nsanje) and (ii) support targeted investments to improve land and water resources management and livelihoods in the Basin.

The Program will address the interlinked challenges of poverty and a deteriorating natural resource base in the Shire River Basin, to halt the process of environmental degradation and improve the productive potential of natural resources. It will promote integrated climate resilient investment planning in the basin, including institutional capacity building, to plan and monitor changes in land use patterns at basin level.

The first Project is expected to involve an investment of about US$145 million and will be implemented over five and half years to support:

- Strategic planning and implementation of large-scale infrastructure investments.
- Adoption of sustainable land, forest and water management practices to reduce land degradation.
- Improvement of productivity and incomes of smallholder farmers in priority catchments.
- Improvement of flood management in the Lower Shire.

The SRBMP is being implemented by the Government of Malawi, through the Ministry of Agriculture, Irrigation and Water Development (MoAIWD). The Ministry has engaged Water, Waste and Environment Consultants to prepare an Environmental and Social Assessment with an Environmental and Social Management Framework (ESA+ESMF) and a Resettlement Policy Framework with Process Framework (RPF+PF).

The project proposes to implement catchment management and income generating interventions that are likely to have impacts on land holdings, sources of income and livelihoods in various communities and areas where the project activities will be implemented. This ESA+ESMF has been prepared to help mitigate against the potential negative impacts and to enhance the positive attributes and benefits of the project to the potentially affected persons.

According to Section 24 (1) of the Malawi Government's Environment Management Act (EMA), Number 23 of 1996; and the Government's Environmental Impact Assessment (EIA) Guidelines of December, 1997, the SRBMP would fall under the list of projects for which EIA is mandatory, prior to implementation. The basis is that the proposed programme constitutes activities, which would generate considerable changes and significant effects to the environment.

The proposed SRBMP has been categorized as A, according to the World Bank's Operational Policy (OP4.01) on Environmental Assessment. Therefore, the appropriate environmental work will have to be carried out. Since not all the locations of the Project-supported infrastructure investments and their potential negative localized impacts could be determined prior to appraisal, this Project involves the preparation of an ESA and ESMF to ensure appropriate mitigation of potential negative environmental and social impacts. The impacts of the largest infrastructure item to be supported under the SRBMP—the upgrading of the Kamuzu Barrage at Lilongwe—are addressed within a separate report, *Preliminary Environmental and Social Impact Assessment: Independent Environmental Impact Assessment for the Upgraded Kamuzu Barrage* (Government of Malawi, December 2011).

This ESA and ESMF is designed to guide the establishment of appropriate level of environmental management measures for implementation, in all the stages of the project activities, from the planning stage to implementation. The Project is designed with environmental sustainability in mind for all components and activities. The environmental impacts of improved coordination in basin water resources management, watershed management, improved regulation of the Shire river, improved climate resilience, and ecosystem improvements are expected to be highly positive overall; likely environmental benefits include improved forest conservation and restoration, reduced soil erosion and land degradation, reduced sedimentation in the Shire River and some of its tributaries, and a reduced risk that the Shire River would run dry during an extended drought. Environmental considerations will be given major attention in Shire River Basin planning, as well as major civil works, to ensure that any adverse environmental impacts are minimized and adequately mitigated. The impacts related to some of the key project activities are described below:

Kamuzu Barrage Upgrading (Sub-component C.1): The upgrading of the Kamuzu Barrage at Liwonde is the most environmentally sensitive Project component, and the reason for why the overall Project is classified as Category A. The most significant environmental and social impacts relate to anticipated changes in the upstream levels of the Shire River and Lake Malawi, as well as downstream Shire River flows. For additional information on the environmental and social impacts (positive and negative) of the Kamuzu Barrage upgrading, please see the parallel report, *Preliminary Environmental and Social Impact Assessment: Independent Environmental Impact Assessment for the Upgraded Kamuzu Barrage* (Government of Malawi, December 2011).[1]

Flood Management (Sub-component C.2): The proposed flood mitigation civil works in the lower Shire Basin are expected to have fairly minor adverse environmental or social impacts because they are relatively small-scale and localized. Nonetheless, attention will be needed to address a range of environmental and associated social issues, such as ensuring sufficient river access and crossing points for animals (domestic and wild) and people since the embankments tend to be rather steep-sided. The wetland conservation and management activities planned around the Elephant Marshes are expected to be highly positive from an environmental standpoint.

[1] Covered in Part 2 of this note.

Catchment Management (Component B): The investments and activities planned under this component are expected to be environmentally positive overall, without significant adverse environmental impacts. These include (i) check dams, gabions, and other small civil works intended to reduce erosion and slow down stream runoff; (ii) alternative livelihood promotion and income-generating activities, which will be screened to rule out any environmentally or socially problematic investments; (iii) community management of natural forests and woodlands on village lands and within the Mangochi-Namizimu and possibly other Forest Reserves; and (iv) protected areas management investments in and around the Lengwe and Liwonde National Parks.

New Water Investments (Sub-component C.3): New water investments planned or designed under the Project might be sensitive from an environmental and/or social standpoint. In general, the Project is intended to promote increased focus on the environmental and social implications of any proposed new investments, based on the capacity-building activities within Component A. Moreover, the Project would support preparation of the environmental and social impact assessments that might be needed for any such new investments.

Shire Basin Planning (Component A): The planning, information management, and capacity-building activities to be supported under Component A are all intended to facilitate increased awareness, understanding, and mainstreaming of environmental and social considerations within water resources planning for the Shire River Basin.

Although the SRBMP activities will vary in size, location, scope and the approach in implementation, most of these activities will involve catchment management and rehabilitation as well as income generating activities. Hence the generic and typical environmental impacts would mostly be positive and would include:

Expected Positive Impacts:

- Reduction in run-off and soil erosion, consequently improving water quality.
- Improved land resources and wetland management.
- Protection of communities and natural resources from flooding.
- Protection of human settlements and social infrastructure for electricity, potable water supply and transport services through water regulation and control.
- Improved and protected wildlife habitat.
- Improvement of carbon storage through forestry interventions, thereby contributing to mitigating climate change impacts.
- Improved water conservation and groundwater recharge.
- Improved management of flooding in the Shire River and its tributaries.
- Increase in the water table through restoration of forest cover.
- Improved water availability for hydropower generation, irrigation activities and water supply.
- Overall protection of ecological balance along the basin.
- Reduced power outages due to reduced siltation.
- Improved aesthetic values.
- Increased economic development along the basin.

- Improved livelihoods through enhanced food security, nutrition and availability of disposable income.
- Reduced reliance on forest resources for charcoal production and income generation.
- Creation of employment opportunities and small scale businesses through increased access to credit facilities.
- Improved water regulation for use by various users in the basin.
- Improved control and removal of invasive aquatic weeds, using the new floating steel boom.
- Reduction in crop and animal damage
- Decrease in economic losses due to flood damages;
- Improved sanitation and hygiene;
- Improvement of food security from irrigated agriculture.
- Increased power supply from existing hydropower infrastructures.
- Management of flow regimes to account for environmental flows;

Potential Negative Impacts (in the absence of planned mitigation measures):

- Removal of vegetation from construction sites.
- Barriers to animals (domestic and wild) or human access to river (to or obtain water) where steep embankments are constructed or reinforced for flood protection.
- Disturbance to and small scale loss of wildlife habitats.
- Changes in water flows and levels.
- Salinization within irrigated fields
- Water logging and stagnation
- Increased generation of both liquid and solid waste from construction works.
- Dust emissions during construction.
- Localized soil erosion.
- Water pollution from agrochemicals.
- Cement pollution from cement sand bags
- Removal of natural vegetation, flora and fauna in and around ponds sites

The Environmental and Social Management Framework (ESMF) has been prepared as a guide to the screening of the proposed SRBMP sites and activities for negative environmental and social impacts, which would require attention prior to project implementation. The ESMF outlines a number of strategies, which include:

- A systematic procedure for participatory screening for project sites and project activities for environmental and social considerations;
- A step by step procedure for forecasting the main potential environmental and social impacts of the planned project activities;
- A typical environmental management plan for addressing negative externalities in the course of project implementation and operations within environs;
- A step by step monitoring and evaluation system for implementation of mitigation measures and;
- An outline of recommended capacity building measures for environmental planning and monitoring of the project activities.

The ESMF recommends that the proposals made herein be implemented adequately to mitigate the consequential environmental impacts of the project activities. It is also recommended that the Environmental Affairs Department and other relevant line ministries should ensure that human activities that lead to deforestation and other environmental problems are properly managed and monitored.

The ESMF also advances that for its implementation to be successful, involvement and participation of local communities is paramount. Specifically it recommends:

- Use this Framework prior to any applicable project activity of the SRBMP;
- Environmental and social awareness education for the key stakeholders and affected communities;
- Training the project implementation personnel in the target districts to implement the ESMF and the screening process;
- Updating the ESMF when needed to respond to changing local conditions and to adjustments in project implementation plans; and
- Building capacities of the City and Town/District Councils to support the environmental and social management process.

As a reference material, the ESA and ESMF will be useful to several stakeholders who will be involved in planning, implementation and monitoring of the proposed project activities. Some of the key users of this ESA and ESMF are:

- Funding agencies/donors for the proposed SRBMP;
- District Executive Committee members in the targeted cities, towns and districts;
- Participating sectors in the implementation of the SRBMP;
- Politicians and local Traditional Leaders;
- Senior Central Government officials responsible for policymaking and project planning;
- Central Government officials responsible for environmental planning and management and;
- Engineers and contractors to be involved in implementation of the project activities.

Finally it is recommended that the following key sections of this ESMF should be included in the Project Implementation Manual: the Screening Process (Sections 5.1-5.6); the Environmental Management and Monitoring Plan (Sections 7.1-7.2); and Capacity Building and Training Requirements (Sections 9.1 to 9.3). The Environmental Rules for Contractors (Annex 4) should also be a part of every bidding document and contract involving Project-supported civil works.

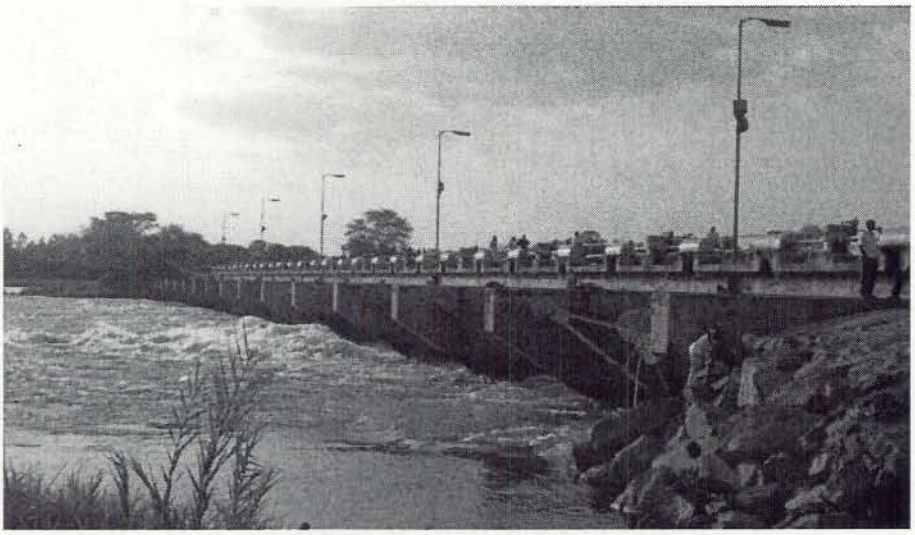
Based on the findings of ESA and ESMF, it is recommended that the project proceed because the project will in the short and long term generate significant environmental and social benefits to the Shire River Basin.

PART 2: Preliminary Environmental and Social Impact Assessment for the Upgraded Kamuzu Barrage

The Government of the Republic of Malawi
Ministry of Agriculture, Irrigation and Water Development

Independent Environmental Impact Assessment for the Upgraded Kamuzu Barrage

Preliminary Environmental and Social Impact Assessment



December 2011

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EXECUTIVE SUMMARY[2]

Background Information

The Government of Malawi, through the Ministry of Agriculture, Irrigation and Water Development (MoAIWD), is currently preparing for the implementation of a National Water Development Project Phase II (NWDP II). Under Phase I of the NWDP, a number of studies were undertaken including: i) Water Resources Development Plan Study to identify future potential sources of water supply, ii) Catchment Rehabilitation and Protection Study, iii) Integrated Water Resources Management Plan for the Lake Malawi and Shire River Study, iv) Songwe River Stabilization Study and v) Strengthening of the Water Resources Board Study.

The Integrated Water Resources Management Plan for the Lake Malawi and Shire River Study (also known as the Lake Malawi Level Control (LMLC)) in Phase I was undertaken to investigate alternatives for regulating Lake Malawi level and Shire River system. A number of options including no action option, construction of a high dam at Kholombizo, refurbishment of the Kamuzu Barrage at Liwonde, construction of a new barrage at Liwonde and construction of a pumping barrage at Samama, were proposed. A feasibility study was conducted to assess the options that should be taken to detailed design. The upgrading of Kamuzu Barrage at Liwonde and construction of the pumping scheme at Samama were selected as the best options.

The feasibility study indicated that lake levels should be maintained between 473.50 masl and 475.50 masl as an acceptable range. It was found that above 476 masl agricultural lands, property and tourist facility losses were expected. It was further concluded that problems for fisheries and lake transport were expected at lake levels below 473.50 masl. At 470 masl negative impacts on commercial fisheries and cichlid fish species were anticipated.

The findings and recommendations of this study partly formed the basis of the preparation of the Water Resources Management Component under NWDP II. The Water Resources Management Component of the NWDP II consists of the five subcomponents namely: Water Resources Management Institutional and Technical Support; Water Resources Investment Strategy; Pilot Catchment Management and Development; Lake Malawi Level Control; and, Enabling Legislation for National Water Policy. Rehabilitation and upgrading of the present lake level control structure, the Kamuzu Barrage at Liwonde is to be undertaken within the LMLC subcomponent in NWDP II. This upgrading of the Kamuzu Barrage will contribute towards reducing risks and stabilizing Shire River flows and Lake Malawi levels over a range of droughts and wet climatic sequences, but not for the most severe drought and wet climatic sequences. The effect of the Barrage on the river flow fluctuations will be insignificant compared to natural long term and seasonal fluctuations. The project area includes three districts, namely Mangochi, Machinga and Balaka in the Southern Region of Malawi.

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[2] The report is a preliminary version of the Final ESIA with Sections completed only where information is currently available. Baseline information is included but is not complete since field work is ongoing.
Completion of the ESIA to a draft standard is dependent on receiving the high resolution colour aerial photography of the Project site and the outcomes (inundation maps) of the hydraulic model being prepared by the Design Consultant. In particular this information is required to assess what public and private assets are affected by the Project and wether resettlement is required. The information is also crucial in further quantifying the environmental impacts of the Project.

Rationale

Kamuzu Barrage which became operational in 1965 is reported to have outlived its life span by about 25 years and some of its parts/sections are not functioning as originally designed. It is also evident that low rainfall in catchment areas of Lake Malawi and the Shire River resulted in lowered lake levels and lack of flow in the Shire River in 1915. This adversely affected livelihood activities such as "dimba" cultivation, Lake transport and the fisheries industry for those living adjacent to the two water bodies and the nation as a whole. It is therefore proposed to upgrade the existing Kamuzu Barrage so as to be able to improve regulation and control of water levels in Lake Malawi and flow in the Shire River.

Project Description

The Project proponent is the Ministry of Agriculture, Irrigation and Water Development. The project involves upgrading the existing Kamuzu Barrage which is located on the Shire River at the town of Liwonde. The preferred design option for the Upgraded Kamuzu Barrage involves: refurbishment of the existing Kamuzu Barrage Structure with new gates; construction of a service bridge and new road bridge immediately downstream of the existing Barrage; and construction of a floating steel boom upstream of the Barrage to control floating weeds. Erosion protection works will also be constructed downstream of the Barrage. Construction time is estimated at 2 years and 10 months.

Environmental Setting

Topography

The Kamuzu Barrage is in Liwonde on the Mangochi to Liwonde rift valley plain. Generally topography of the Project area can be divided into three distinct categories which include the rift valley floor, the plain north of the barrage and the hilly forested Machinga Forest Reserve that lies south of the Barrage towards Zomba.

Soils

Sandy soils with coarse grains and light texture with good air circulation are very common in the project area. Fertile alluvial soils with fine particles and heavy texture are found along the flood plain of the Shire River, Lake Malombe and shores of Lake Malawi. These soils support a variety of crops including maize and rice.

There are also hydric soils in the riparian zones of Lake Malawi, Lake Malombe and the Shire River. These are soils that are formed under conditions of saturation, flooding and ponding long enough in the growing season to create anaerobic conditions in the upper 50cm. of the soil.

Hydrology/ Geology

Flow in the Shire River is determined by the outflow from Lake Malawi and in flow from the drainage basin downstream of the Lake (Norconsult, 1997). Lake outflows account for all almost all the water entering the Shire River. The Kamuzu Barrage provides flow regulation in the Shire River downstream of Liwonde and limited control of water levels upstream in the Shire River, and Lakes Malombe and Malawi.

Geology at the Barrage site consists of mainly fluvial sandy soils with firm layered residual soils and weathered rock underneath.

Climate

There are three relatively distinct climatic seasons in the Lake Malawi area. Cool and dry weather with south-easterly winds predominates from May till August with air temperatures along the lakeshore dropping as low as 15°C. A short hot and dry period occurs from September to November while the rainy season normally lasts from late November till April. In the rainy period the average temperature is around 28°C and the wind direction is predominantly northerly.
The Upper Shire reach stretching from the outflow of Lake Malawi to Matope is a relatively dry area with a mean annual rainfall of around 700 mm. The average annual temperature is around 22°C.
The Middle Shire River area stretching from Matope to Maganga has a slightly higher rainfall than the upper part with 700-800 mm of rainfall. The mean annual temperature is also slightly higher being approximately 24°C.

Vegetation
The commonest vegetation type in the project area is miombo woodland (Brachystegia julbernadia) occurring on the adjacent Machinga Forest Reserve and other hills in the Liwonde National Park. Hydrophytic plants which include reeds, hippo grass, and other water loving plants are common along the riparian zones.
Six (6) distinct biotic communities were identified as being represented within the project area during the field assessment, namely:

- Perennial Marshes
- Seasonal Marshes – Uncultivated
- Seasonal Marshes - Under Cultivation (dambos)
- Seasonal Flood Plains
- Riverine Woodlands; and
- Dry Bush Savannah

Wildlife
The project area spans over a variety of habitats from open water, floating meadows, lagoons and reeds, floodplain, grassland, woodland and mixed woodlands. The immediate habitats around Shire River and Lake Malombe includes the wetlands, open grasslands and mixed woodlands. Wetlands and open short grasslands occupy most of the floodplains. The extent of coverage varies from place to place but the project area being generally flat allows water stagnation during flooding and raining.
There are many species of conservation interest. Records show that a number of protected areas in the project area now harbour reintroduced species after the previous populations became locally extinct mainly due to hunting or habitat loss. Of key interest include crocodiles, rhinos, roan antelopes, buffaloes, eland and zebra. There are also species translocated to Liwonde National Park from Kasungu National Park in the north in order save them from local extinction. However, wildlife population trends from annual census conducted by Liwonde National park suggest that the populations of most large game species are stable.
Important bird species include the globally near threatened African Skinner which utilises river sand bars and the highly localised Rock Pratincole which utilises emergent boulders in the Shire River channel.

Fishes
Chambo (Tilapia) fish species that include; Oreocromis lidole, Oriocromis karongae are among species of commercial importance. Opsaridium microlepis (Mpasa or Lake salmon), a cyprinid and a lacustrine fish

species, is the most commercially viable riverine species in Malawi. Mpasa is at the verge of extinction in Malawian natural waters although there appears to be some remnants in Liwonde National Park where it is still found in good numbers. Mud fish and others that are not very popular commercially are also found locally.
The fish community of Lake Malawi consists of 500-1000 species. Of major importance in terms of species diversity is that nearly 100% of the cichlids are endemic to Lake Malawi (i.e. they are found nowhere else in the world). Moreover, many of the cichlid species have a very restricted distribution within the lake. This is particularly the case among the rock-dwelling mbuna which utilise the rocky shores.

Land Use
Major land uses in the project area include; agriculture, grazing, human settlement, commercial enterprises, protected areas and tourist/recreational developments such as hotels and lodges along the Lake shore and Shire River areas are used for hotels and cottages.

Livelihoods
Fishing and fish vending are among the major livelihood activities at Liwonde Barrage as well as at Mangochi and other places on the lake shore. Individuals in these places derive their food and cash income from fishing, processing or selling fish. Commonest fish species landed include Usipa, Kampango, Mlamba, Kambuzi, Mcheni and Chambo. Fish catches are generally dwindling.

Settlement
House structures - Sun-dried and burnt bricks are common building materials in rural areas. Most of the houses are grass thatched and a few have iron sheets. There are very few permanent houses in the rural areas.

Transport and Communication
Minibuses, pickups and small three tone trucks are commonly used to transport people as well as goods within and between districts. Bicycles are also commonly used to transport people especially in district centres. The existing Kamuzu Barrage provides an important regional and local transport link across the Shire River
Ground and mobile telephone services such as Airtel, MTL, and TNM are available in many parts of the project area though some have weak signals.

Health
The project area is well serviced by government and private hospitals. There are also health centres in many parts of the rural communities. Malaria is very common in the area.

Ethnic Composition
Chiyawo and Chingoni are the main local languages. Chichewa is spoken by everybody because it is a national language. People of other tribes are those employed by government or doing business in the project area.

Religion
Most residents in the project area are Muslims followed by Christians mainly Roman Catholics. Mangochi and Machinga districts are dominated by Muslim comprising more than 50 % of the residents. Conversely, Balaka district residents are predominantly Christians (67%).

Social and Environmental Impacts

Beneficial Impacts

Reliable hydropower generation - The upgraded barrage will help with the control and regulation of lake water levels and flow of the Shire River providing more reliable generation of hydropower.

Improved transport and communication - The upgraded barrage will be stronger and wider providing both motorists and pedestrians a useful, easy and safe access to health clinics, trading centres, markets and other places where they access goods and services. Upgrading the Barrage will enhance the benefits people are currently getting from the existing Barrage.

Economic benefits - Besides direct employment, the likelihood of people in the area benefiting economically from the project through establishment of small scale businesses such as groceries, restaurants, houses for rentals, sale of agricultural produce and fish at the local market and by the road side is high. Significant economic benefits will be enjoyed in the project area.

Employment opportunities - The likelihood that upgrading of the Barrage will create employment opportunities and bring about economic benefits to people in Liwonde, Machinga, Mangochi and the neighbouring districts is very high. Employment opportunities created will be beneficial both locally and nationally.

Alternative livelihoods - Vending of fish both fresh and dry is, at present, the major livelihood activity in the project area particularly at the Barrage. Increased population as a result of the influx of people and movement of people in the area will bring about different demands for goods and services. The varied demands will provide opportunities for entrepreneurs to venture into new livelihood activities.

Improved Standard of living - Direct cash income from employment by the project and money realized from rentals, sale of agricultural produce and other commodities will enable people in the project area and beyond to meet their basic needs and afford essentials such as food, clothing and good houses which will raise their living standards.

Community skills development - The many activities to be undertaken during Barrage upgrading works will likely require the contractor to train some local people as plant operators, technicians, electricians and mechanics, clerks and storekeepers. The acquired skills will benefit the individuals as well as communities in the project area during and after the project life.

Adverse Impacts

Soil Erosion/land degradation - Clearing of vegetation and earth moving works during the upgrading of the Barrage is likely to cause accelerated erosion in the project area with sediments contaminating water in the Shire River and silting up spawning grounds on the river bed. These impacts are expected to be short term and minor.

Air pollution Use of plant and equipment during construction may lead to air pollution. The impact is expected to be short term and minor.

Water pollution - Silt, solid wastes and oil from the construction site may spill into the Shire River contaminating its waters and possibly killing some organisms as well as impacting on downstream water users. Impact is expected to be short term and moderate.

Wildlife – The primary cause of impact to the terrestrial environment resulting from implementation of the project will be associated with changes in environmental flows and flooding regimes. These impacts will be most pronounced in the low gradient areas of Lake Malawi, Lake Malombe and the Upper Shire River principally on the floodplain and in the River channel.
Increased flooding in the riparian zone during Barrage operation may cause loss of habitats upstream and downstream of the Barrage. Sand banks are utilised by crocodiles for nesting and some of these areas may become inundated as a result of higher water levels from the refurbished Barrage.
Sand bars in the River channel which are also susceptible to inundation from higher water levels are used as roosting sites by the African Skinner. Similarly, emergent boulders in the Shire River which provide habitat for the Rock Pratincole may also be inundated as a result of the refurbished Barrage. A quantitative assessment of impacts which is dependent on the revised hydraulic model for the Shire River in the Project area will be included in the Final ESIA. If impacts do occur they are expected to be long term and possibly significant.

Fish - Rising water levels upstream of the Kamuzu Barrage could potentially affect fish habitats, including for the highly diverse assemblage of Mbuna cichlid fish species that inhabit shallow rocky waters in Lake Malawi. The extent of the impact if any will be assessed once the hydraulic model is updated and included in the Final ESIA.
Although the Barrage is a barrier to upstream migration of fish, the impact is lessened (though still permanent) by the natural barriers in the Shire River created by a series of waterfalls in the Middle Shire between Liwonde and the Elephant Marsh.

Vegetation – Riparian floodplain vegetation communities in Liwonde National Park which is located immediately upstream of the Barrage are also susceptible to impacts from prolonged flooding as a result of the refurbished Barrage and its operation. These impacts would be long term and potentially moderate to severe. A quantitative assessment of impact will be included in the Final ESIA once the hydraulic model and inundation maps are completed.

Involuntary resettlement - Some families may be required to relocate due to the effects of the Barrage upgrading. This may occur around the Barrage road approaches and upstream areas along the Shire River banks and the foreshore areas of Lakes Malawi and Malombe. The RAP for the Project will provide a quantitative assessment of resettlement.

Loss of farmland - borrow pits and disposal sites for gravel and other solid wastes may cover farm land making it unavailable for cultivation. The rise in water levels upstream of the Barrage may also result in loss of "dimba" land for cultivation. Any impacts will be quantified in the Project RAP and included in the Final ESIA.

Tourist Facilities –Severe River bank erosion is already occurring adjacent to the main accommodation camp in Liwonde National Park such that the Park Service has had to construct river bank protection works (rock gabions) to protect its camp site. The refurbished Barrage may further exacerbate the problem depending on the new operating scenario. The impact would be long term and major.

There is also a possibility that some tourist facilities along the shores of Lake Malawi (beaches rather than structures) would be impacted by the refurbished Barrage. This impact will be further considered in the Project RAP.

Traffic hazards during construction – increased vehicle movements, especially heavy vehicles will lead to a temporary increased risk of accidents during the construction period.

Health impacts - Borrow pits if not reclaimed soon after construction works can fill up with water which provides breeding grounds of water-borne vectors for malaria and, bilharzias. Individuals contract bilharzias as they swim and wash clothes in the stagnant water in the pits.
Influx of workers and job seekers into the area is very likely to introduce new life styles and increase the incidence of diseases such as HIV/AIDS and other communicable diseases. Drug and alcohol abuse may also increase in the project area due increased affluence and higher population. Impacts are likely to be long term and moderate.

Noise and vibrations - The barrage rehabilitation activities are likely to include blasting, crushing and transportation of materials and personnel using heavy vehicles. Machines used in all these undertakings produce noise and vibrations. Impacts are expected to short term and minor.

Environmental Management Measures

The Environmental and Social Management Plan (ESMP) outlined in Section 8 addresses mitigation measures, monitoring and institutional arrangements for the environmental management of the Project. The purpose of the environmental monitoring program is to ensure that the envisaged outcome of the Project is achieved and results in the desired benefits to Malawi. To ensure the effective implementation of the ESMP it is essential that an effective monitoring program be designed and carried out. The environmental monitoring program provides such information on which management decisions may be taken during construction and operational phases. It provides the basis for evaluating the efficiency of mitigation and enhancement measures and suggests further actions that need to be taken to achieve the desired Project outcomes. The table below outlines the proposed environmental monitoring to mitigate the adverse Project impacts.

Environment Component	Project Stage	Parameter	Standard	Location	Frequency	Duration	Implementation	Supervision
Land Acquisition and Compensation	Pre-construction / operation	Ensure compensation paid as per RAP	RAP	All work sites	Monthly until complete	As per RAP	MoAIWD	EAD
Downstream hydrology	Construction / operation	River levels, bank erosion	ESMP	Shire River channel	Daily River levels; monthly bank erosion	Ongoing with annual review	MoAIWD	EAD
Operation release strategy	Operation	Operational discharge	ESIA	Downstream of Barrage	Daily	Project life	MoAIWD	EAD
Vegetation	Operation	Vegetation communities	ESIA	Liwonde NP	Every 2 years	Review after 10 years	MoAIWD	EAD
Wildlife	Operation	Key species	ESIA	Upstream / downstream	Every 2 years	Review after 10 years	MoAIWD	EAD

Environment Component	Project Stage	Parameter	Standard	Location	Frequency	Duration	Implementation	Supervision
Water Quality	Construction	pH, EC, SS, turbidity, colour, NH4+, NO3-, total P, Fe, DO, BOD, grease & oil, E-coli	WHO guidelines	Construction Camps	Monthly during operation of camps		Contractor	Supervision Consultant
Noise Levels	Construction	Noise levels on dB (A) scale	WHO guidelines	All work sites	Monthly as required by Supervision Consultant		Contractor	Supervision Consultant
		Noise levels on dB (A) scale	WHO guidelines	Noise level readings taken at nearest residential house to work site	As directed by the Supervision Consultant	Readings to be taken at 15 second interval for 15 min every hr and then averaged	Contractor	Supervision Consultant
Soil Erosion	Construction	Turbidity in storm water	ESIA guidelines	As identified by MoAIWD	As required		Contractor	Supervision Consultant
Vegetation Clearing	Construction	Monitor clearing to ensure consistent with EMP	ESMP	All work sites	As required		Contractor	Supervision Consultant
Rehabilitation of Work Sites	Construction	Monitoring to ensure all work sites are progressively rehabilitated	ESMP	Work camps, material storage sites, borrow areas, quarry	As required		Contractor	MoAIWD
Health	Construction	Signs, posters displayed, health awareness lectures, health checks for workers	ESMP	All work sites, work camps and surrounding areas	Monthly		Contractor	MoAIWD
Accidents	Construction	Safety training for workers, accident reports, community consultation	ESMP	All work sites	Monthly		Contractor	MoAIWD
Implementation of ESMP	All stages	All	ESIA	Project impact area	Monthly	Life of Project	MoAIWD	EAD

In addition to the monitoring, the Contractor for construction of the refurbished Barrage will be required to prepare a Contractor Environmental Management Plan (CEMP) based on the ESMP accompanying the Final ESIA. Contract documents will also include specific environmental requirements from the ESMP.

An environmental training program targeting both the Project proponent and Contractor has also been included in the mitigation measures to improve their capabilities in environmental performance.

Key Actions to be Implemented

- Revised operating plan for Kamuzu Barrage taking into account environmental requirements both upstream and downstream of the Barrage (prepared as a component of the SRBMP).
- Implementation of the relocation and compensation program as outlined in the Project Resettlement Action Plan which is in preparation.
- HIV/Aids awareness campaign for communities and contract workers.
- Preparation of a disaster preparedness and response plan dealing with flood management as well as Barrage failure.
- Implementation of environmental monitoring plan as outlined in Section 8 of this Report.
- Referral of the ESIA to the Governments of Mozambique and Tanzania in accordance with the SADC revised Protocol on Shared Watercourses;
- Establish a Panel of Experts to oversee construction, Barrage safety and environmental management.

The estimated compensation and monitoring costs required to address the social and environmental impacts associated with the Project is USD 564,500. These costs exclude any costs associated with resettlement and/or compensation which will be provided once the Resettlement Action Plan for the Project is completed, in parallel with the Final ESIA.

Overall conclusion

There is a strong economic justification for the refurbishment of Kamuzu Barrage. The enhanced reliability of flows downstream would benefit downstream water users, most notably hydropower generation, urban water supply, and irrigation, which would boost the economy of Malawi. Furthermore, there would be job opportunities for local communities during construction work. Many of the adverse impacts will be of a temporary nature during the construction phase and can be managed to acceptable levels with implementation of the recommended mitigation measures in the EMP for the Project such that the overall benefits from the Project will greatly outweigh the adverse impacts. Long term impacts are mainly related to the flow releases from the Barrage and provided an operating regime which takes into account social, economic and environmental needs downstream, is maintained then these impacts can be managed acceptably.
Long term impacts may also occur upstream of the refurbished Barrage but the impacts are limited because of the narrow range of influence the Barrage has in controlling River and Lake levels upstream and the environmental boundary conditions (to be included in the Final ESIA) which will be incorporated into Barrage operation.