Executive Summary

Uganda is currently facing a huge electricity supply deficit; it has one of the world's lowest levels of electricity development as well as the lowest per capita electricity consumption. Over 90 percent of the country's population is not connected to the national grid, much of the electricity network at present is poorly maintained and country the experiences frequent power cuts. According to the National Development Plan (NDP- 2010/11-2014) the present peak demand of Uganda is about 400 MW or more which has been growing at an annual rate of 8%, to meet this growth with demand about 20 MW of new generating capacity needs to be added each year. NDP further identifies that, current levels of electricity supply cannot support heavy industries limited generation capacity and corresponding limited transmission and distribution network as among other key constraints to the performance of the energy sector in the country.

Given the large and growing gap between electricity supply and demand in Uganda, a number of electricity generation alternatives were explored under Rural Electrification Programme for next 20 years. Studies over various planning horizons were also examined and prioritized for the country under the Hydropower Master Plan. The conclusions from the evaluation of these generation alternatives reveals that large scale hydroelectric development is the most economical way forward for the country in the short-medium term. Therefore, to meet the growing electricity demand seven potential hydropower sites have been examined downstream of Bujagali Hydro Power Project (which is already under construction) over River Victoria Nile from Lake Victoria to Lake Albert as river is the primary hydrological resource available in country. Seven potential hydropower sites identified are:

- Kalagala
- Isimba
- Karuma
- Oriang
- Ayago
- Murchison
- Kiba

The current situation of the power demand and power supply options for Uganda indicate that the Karuma HPP is a very justified development as it will add up to 600MW to the National Grid and it is the preferred and least cost solution to address the short, medium and long term power shortages in the country.

1.0 INTRODUCTION

The Karuma Hydro Power Project proposed by Ministry of Energy and Mineral Development (MEMD) and Uganda Electricity Generation Company Limited (UEGCL) as a run of the river scheme is located on the Kyoga Nile River at 2.5 km upstream of Masindi- Gulu Highway. Project area falls within Kiryandongo and Oyam Districts of Uganda located in the vicinity of Karuma village and Murchison Falls Protected Areas including Karuma Wildlife Reserve. The Tail Race System, the access adits and surge chambers will be located within Karuma Wildlife Reserve but, outside the Murchison National Park however, most of the project components such as the underground power house, the weir and Head Race Channel will be located - outside the Murchison National Park as well as Karuma Wildlife Reserve area. The Project will utilise a gross head of about 70 m and design discharge of 1128 cumecs for generation of 600 MW (six units of 100 MW each).

Earlier Karuma hydropower Project was entrusted to M/s NORPAK for development under the private sector with an installed capacity of 200 MW on Kyoga Nile River. M/s NORPAK undertook the Environment and Social Impact Assessment (ESIA) study and duly submitted ESIA report prepared to NEMA for approval. NEMA in the year 1999 approved ESIA and the other related permits. In the year 2006, M/s NORPAK revised the project in two phases with 100 MW installed capacity in the first phase and 100 to 200MW capacity. But, due to host of reasons NORPAK decided not to pursue the project any further and it was reverted back to Govt. of Uganda for implementation.

1.1 PROJECT DESCRIPTION

The proposed scheme consists of a Dam of maximum height of 20.0 m and length of 311.53 m at the Top elevation of 1032.00 m. Full Reservoir Level will be at El. 1030.00 with 79.87 MCM storage at FRL and Live Storage will be 45.53 MCM. The Overflow bays have been proposed to discharge the design flood of 4700 cumecs, and constitutes of 14 surface bays of 7.0 m width and 10.0 m height with the crest at EL 1020.0 m. 2 under sluices of 3.0 m wide and 4.0 m height have also been proposed as a silt flushing arrangement for the power intake structure. The Non overflow length of 33.74 m covers the left abutment and 96.56 m on the right abutment. For energy dissipation, stilling basin with end sill has been proposed. Except the diversion structure, diversion channel and TRT outfall all other project components are proposed to be underground. Location map of the Karuma HPP is presented **in Figure 1.1;** whereas salient features of the project are presented in **Table 1.1**.

Total land requirement of the Project for construction facilities is tabulated below in **Table 1.2** and the Layout Plan showing the Land requirement for the construction facilities is provided as **Annexure 1.1.**

Figure 1.1: Cascade Development on River Nile

Table 1.1: Salient features of Karuma Hydropower Project

1	**Location**	
	Country	Uganda
	District	Kiryandongo
	Village	Karuma
	Access	
	Airport	Entebbe - 300 km (Via Kampala)
	Road Head	1. From Kampala – 270 km 2. From Gulu – 75.0 km
	Geographical co-ordinates of Dam Site	
	Latitude (N)	1^0 29'45''
	Longitude (E)	32^0 49'45''
	Map reference	Department of Lands and Survey of Uganda topo-sheet No. 31/3
2	**Meteorology**	
	Average Annual Rainfall	
	Maximum Rainfall	2000 mm
	Minimum Rainfall	900 mm
	Atmospheric Temperature	
	Average Maximum Temp.	28 ^{0}C (at Kampala)
	Average Minimum Temp.	17 ^{0}C (at Kampala)
3	**Hydrology**	
	Catchment Area	346,000 sq. km
	PMF	4700 cumecs
4	**Reservoir**	
	Maximum Water Level	El. 1030.00
	Full Reservoir Level	El. 1030.00
	Minimum Drawdown Level	El. 1028.00
	Water Spread at FRL	2737.35 Ha
	Water Spread at MDDL	1790.35 Ha
	Storage at FRL	79.87 MCM
	Storage at MDDL	34.34 MCM
	Live Storage	45.53 MCM
5	**Dam**	
	Type	Concrete Gravity
	Length at top	311.53 m
	Overflow	169.39 m
	Non-overflow	142.14 m
	Top Width	6.00 m
	Top of Dam	El. 1032.00
	Maximum Height above deepest	20.00 m
	River Bed Level (average)	El. 1019.00 m
6	**Coffer Dam**	

	Type	Dumped Rockfill with Concrete Membrane on upstream face and jet grouting in foundation.
	Maximum Height	15.00 m
	Top Width	4.00 m
7	**Diversion Channel**	
	Size & Shape	A diversion channel of base width 10.00m, length of about 700.00m, side slope of 1:1 and
	Diversion Discharge	2500.0 cumecs
8	**Spillway Arrangements**	
	Type	Submerged Ogee Spillway
	No. of Gates	14Nos.
	Size of Gates	7.50m(W) X 10.00 m(H)
	Crest Level	El. 1020.00 m
9	**Silt-Flushing Arrangements**	
	Type	Under Sluice
	No. of Gates	14 Nos.
	Size of Gates	3.00 m(W) X 4.00 m(H)
	Crest Level	El. 1012.00 m
10	**Power Intake**	
	Type and Location	Rectangular fore bay type with inclined trash rack on Left Bank of Kyoga Nile and inclined
	Size	175.20 m long and 20.0 m high
11	Pressure Shafts	
	Nos., Diameter and type	6 Nos.,7.70 m diameter, Underground
	Length	Length varying from 328.59 m to 379.18 m
	Liner	Steel liner thickness of 22.0mm in the bends and Concrete Liner of 500 mm on straight
12	**Power House**	
	Type and Location	Under Ground Powerhouse on Left bank of Kyoga Nile about 400.0 m downstream of
	Design Discharge	1128.02 cumecs
	Design Head	59.83 m
	Size	215.0m (l) x 21.0 m (w) x 49.0 m(h)
	Type of Turbine and no. of units	Vertical Francis, 6 units of 100 MW each
	Installed Capacity	600 MW
	Turbine Centre Line Level	EL. 925.09 m
	Service Bay Level	EL. 962.55 m
	Tailrace system Between Power House and Surge Chamber	Six Individual 7.70 m horseshoe shaped tunnels with 276.81 m long each
13	**Surge Arrangements**	

	Surge Chamber with Tunnels	A Down Stream Surge Chamber of 200.0 m (L) X 20.0 m (W) X 29.00 m (H) with 3 Nos of 12
14	**Tailrace System**	
	Tailrace Tunnels	Two Numbers of 12.50 m Horse shoe shaped tunnels and 8.3km Length
	Tailrace Channel	Open Channel of 100 m wide with side slope of 1:1 and 140.0 m length
15	**Power Generation**	
	Rated net head at Design Discharge	59.83 m
	Installed Capacity	6 X 100 MW = 600 MW
	Design Energy: Annual generation in	4309.33Million Unit

Table 1.2: Land Requirement for Construction Facilities in Karuma HPP

Total Required Land Area for Construction facilities	465.52
Land already acquired as per NORPAK Proposal is 123.23 ha, of which land to be used as per present layout	34.17
Additional area to be Acquired for Construction facilities	431.35

Break up of total project cost estimates for Karuma HPP are shown in **Table 1.3** below. The tariff of the project is worked out based on Present day cost and completed cost.

Table 1.3: Completed Cost

Basic Cost at Dec'10 price level	US$ 1,612 Mn
Escalation	US$ 188 Mn
Hard Cost at Completion	US$ 1,800 Mn
Interest During Construction and Financing Charges	US$ 409 Mn
TOTAL PROJECT COST	US$ 2,209 Mn
Tariff in First year	US$ 0.1021 per / kWh
Levellised Tariff for 40 years	US$ 0.0787 per / kWh

1.2 ALTERNATIVE HYDROPOWER CONFIGURATION

A total of Five Alternative layouts had been investigated for Karuma HPP. Key considerations in the comparison were the potential power output of the different options, their financial costs and their relative environmental and socio-economic implications.

Considering the sensitivity related to serious adverse effect on the Karuma Wildlife reserve and Environmental problems, alternative number –I, IV and V were not pursued. Therefore, the two viable alternatives considered were Alternatives - II and III. The benefits of alternatives II and III were almost similar as each of the alternative required almost similar length of tunnelling but, cost of Alternative-II

was little lower than III. Also, in Alternative- II, the underground Power House is located substantially far away from Kampala Gulu Highway and all the access tunnel, cable tunnel etc. will be located away from the Highway and the conservation zone. Since the cost and benefit of both alternatives II and III were comparable to each other, Alternative II had been adopted for further survey and investigations and later approved by MEMD.

1.3 PLANT OPERATION AND MAINTENANCE

1.3.1 Concrete Dam and Spillway

The spillway gate will be maintained periodically with the guidelines stipulated by the gate manufacturer. For maintenance of spillway gates sufficient arrangements for stop log gates also has been provided with in the Dam structure. The reservoir level will be continuously monitored with the gauges installed with the dam Site accordingly the power plant will be operated. Automatic and remote controlled radial gates will ensure reservoir level maintenance.

The fish pass will always be in operation and through which the mandatory environmental flow will always be discharged. Initially the environmental flow was calculated 50 cumecs, however which is now revised to 100 cumecs after the recommendation of Directorate of Water Resource Management which is given as **Annexure I**. Now, 100 cumecs of environmental flow will be discharged in the downstream for maintaining aquatic biodiversity. The periodic maintenance will be carried out for the fish pass gates as per the manufacturer's recommendations.

1.3.2 Water Conductor System

The initial filling for pressure shaft will be done as per the international practices, during which the entire alignment of pressure shaft will be continuously monitored for leakages. Sufficient arrangements have been provided for dewatering purposes which may required for carried out the maintenance works The floating debris which is likely to be accumulated in front of power intake will be removed with the mechanically operated trash rack cleaning machine. The trash rack and intake gates will be continuously monitored and sufficient arrangements are provided to carry out the periodic / emergency maintenance work.

1.3.3 Power House

The power house machines are designed with 10% overload capacity to achieve the installed capacity of the project even unavailability of one of the machine during maintenance. The Draft tube gates are

provided to facilitate the dewatering process in the power house during maintenance of turbines and its accessories.

2. ESIA FOR KARUMA HPP

As a part of any environmental impact assessment study it is imperative to determine the baseline levels of appropriate environmental parameters, which are likely to be affected as a results of construction and operation of the proposed project. In view of the changed scope and layout of the works a new ESIA has been deemed necessary (Table 2.1) also, the ESIA report prepared by NORPAK represent data of 10 year back situations.

Table 2.1: Summary comparison of the NORPAK and Current Proposal features

Salient Features	Project	
	NORPAK	Current Proposal
Proposed Capacity (MW)	200	600
Land Take (Ha)	123.23	465.52
Tail Race Tunnel (Km)	2.2	8.3
Weir/Dam Height (M)	20	20
By passed River length (Km)	2.8	14
Proposed Environmental Flow (cumecs)	50	100

The Environmental and Social Impact Assessment (ESIA) report has been prepared in compliance with the EIA guidelines (1997), the EIA regulations (1998), the provisions of the Uganda Wildlife Act Cap 200 regarding EIA of Uganda and in accordance with standards, safeguard procedures and guidelines of international agencies including African Development Bank (ADB) and the World Bank. The ESIA describes the existing/baseline conditions of the environment of the project area and highlights the potential positive (benefits) and negative impacts of the proposed development. It also proposes various mitigation measures and monitoring framework to address the impacts and enhance the benefits.

To evaluate the compliance of the project to both international and national guidelines, standards and safeguards, a review of the legal, policy and institutional framework has been done and details are provided in **Chapter 2 ESIA Methodology and Regulatory Framework** of main ESIA report.

3. BASELINE STATUS OF PHYSICAL ENVIRONMENT

3.1 STUDY AREA

For the purpose of ESIA for the proposed Karuma HPP, study area of Influence was defined as follows:

- Submergence area (area within the high flood level of the water spread area)
- Area within 2 km of the periphery of the project appurtenances where the impacts can possibly be visualized.

The sampling of physical parameters like air, water, noise and traffic etc. and field survey for the ecological study has been conducted during the dry seasons i.e. in the month of May and June. The survey was conducted after consultation with the authorities and field officers while, sampling of data was done as per the specific requirements of the parameter studied. Overall description of the methods and practices used for studying the ambient status of each environmental parameter in the study area is provided in the **Chapters-3 Methodology for Baseline Assessment** of the main ESIA report.

3.2 GEOLOGY OF THE PROJECT AREA

Mesoscopic structural data were recorded in the rocky outcrops to decipher the macroscopic structural set up of the area, and the possible thickness of overburden was estimated on the basis of vertical to moderately dipping cliffs and quarry sections available on either bank of the river. Detailed geological mapping on 1:1000 scale were carried out along the project layout and along south and north banks of the river, wherever accessibility was possible. Broadly the geological set up of the Project area can be subdivided into two categories, viz., and overburden and bedrock.

3.2.1 Geomorphology

Geomorphologically the area represents a mature topography and the project area may be subdivided in to three categories, such as, Peneplain, denudational slopes and river valley. On the north and south banks of the river Kyoga Nile, the area extending between Marchison Falls (d/s of TRT outfall) and Lake Kyoga (u/s extent of the reservoir), is predominantly near flat terrain giving rise to peneplain topography. Small raised grounds forming hummocks and ridges are also noticed at different locations, giving rise to rolling topography. Ground elevations in the project area vary between EL. 960 m to EL. 1075 m. The area adjacent to the proposed Dam & Power Intake Structure is characterized by a relatively flat topped peneplain located about 30 to 50 m above the river bed.

3.2.2 Seismicity

The Karuma Falls area is located within the shield area, but only 50 – 100 km from the western rift and about 70 km south of the Aswa Fault Zone, thereby potentially affected by the major tectonic features of regional scale The seismic hazard assessment studies indicate that the Earthquake hazards are not very high in the project area and not negligible either.

3.3 SOILS

More than 50 % of the study area is under Petric Plinthosols followed by Gleysols (12.73%) and Acric Ferralsols (11.97%), Arenosols (7.29 %) and Histosols (2.01 %). The Petric Plinthosols are mainly around the sites and locations of the project components, including the KWR area. The descriptions of the soil classes are presented in **Table 3.1.**

Table 3.1: Soil classification with 2 km study area of Karuma HPP

S. No.	Soil Class	Area (ha)	% Area	Vulnerable to Erosion
1	Petric Plinthosols	10547.60	50.05	Yes
2	Arenosols	1535.33	7.29	Yes
3	Acric Ferralsols	2521.82	11.97	Yes
4	Gleysols	2683.05	12.73	No
5	Histosols	423.47	2.01	No
6	Waterbody	3363.02	15.96	-
	Total	**21074.28**	**100.00**	-

3.4 LAND USE- LAND COVER CLASSIFICATON

Part of project area which falls within KWR (on the left side of the Kampala-Gulu/Arua highway) mainly is dominated by pristine vegetation. While, the right side of the highway at Karuma is dominated by commercial structures forming the Karuma township. The main project area adjacent to diversion site is generally dominated by local farming activities and scattered low income settlements. The land use land cover data indicated that most of the land within 2 km study area is under subsistence farmland (more than 40%) where mostly crops like Cotton, maize, Banana, Sugarcane, Cassava etc. are grown. Subsistence farmland is followed by tropical high forests (almost 20%) and Papyrus swamp (more than 12%). Papyrus swamp is mostly along the riverbank or in wetlands.

3.5 CLIMATE

The climate of the project area comprise of dry and wet seasons with rainfall distributed in two wet seasons, namely: March to June and August to November. Average annual rainfall received is 1500 mm. The project area has a bimodal rainfall pattern with a short dry spelt in July and one long dry season from late November to early March. Mean monthly rainfall ranges from 14 mm in January to 230 mm in August. The micro-climate of the area is hot and humid with an average relative humidity of 60%, mean maximum temperature of 29°C, mean minimum temperature of 22°C and wind speeds of 8 kmph.

3.6 HYDROLOGY

River Nile is the only outflow from Lake Victoria. From Lake Victoria, the River arises just outside Jinja, where a monument is there at the spot; the river goes through Bujagali falls about 15 km downstream of Jinja. It then flows generally north and westwards and enters into Lake Kyoga in the centre of Uganda. The 130 km stretch of Nile from Lake Victoria to Lake Kyoga is called Victoria Nile. After leaving Lake Kyoga, it flows in the western direction for about 25 km and is called Kyoga Nile. At Masindi Port, the river turns north and then after passing Kamdini, it turns west to arrive at Karuma Falls after about 95 km. About 5 km upstream of Masindi Port, the Kyoga Nile receives its largest tributary within this reach – the Kafu River. Kafu River drains basin area of about 13,000 sq km and during flood season, it may substantially increase the Kyoga Nile flows. Between Masindi Port and the Karuma Falls several minor tributaries flow into Kyoga Nile but their impact on the main river flow is limited. Various studies have indicated that the average flow of the largest of these tributaries – river Tochi does not increase the annual flow of Kyoga Nile by 1 %. After emerging from Lake Kyoga the River flow in a relatively flat reach and then enters a series of rapids and falls. At Karuma Falls, the river sweeps under Karuma Bridge located at Latitude 2^0 14' 46'' N and Longitude 32^0 15' 09'' E at the southeastern corner of Murchison Falls National Park.

3.7 CATCHMENT AREA

The Catchment area of the River Kyoga Nile up to the Project site is about 346,000 sq km, of which the Catchment area up to Jinja, located downstream of Lake Victoria is 264,160 sq km. The base flow of River Kyoga Nile at Karuma is generally dominated by the outflows from Lake Victoria. To ensure that the pre – dam natural relationship between lake levels and outflows to Victoria Nile does not change, the outflows releases from the Lake Victoria are made as per the Agreed Curve developed during an Agreement between Uganda and Egypt (1949 and 1953).

The Weibull's method has been used for estimating the percentage dependability. Annual flows for Karuma HPP for the period 1940 to 2000 have been arranged in descending order. From the analysis, it is revealed that 50 % dependable annual flow work out to be 32602 MCM, which correspond to the year 1975 respectively. The monthly discharges during the 50% dependable years of 1975 are given in **Table 3.2**. Monthly flows corresponding to 50% dependable year viz.1975 have been utilised for estimating the installed capacity for the project.

Table 3.2: Monthly Discharges for 50% Dependable Years (Cumecs)

% Dependability	**50%**
Month	**1975**
Jan	978
Feb	953
Mar	901
Apr	932
May	849
Jun	816
Jul	863
Aug	962
Sep	1091
Oct	1432
Nov	1392
Dec	1238
Mean Annual (Cumecs)	**1034**
Annual Yield (MCM)	**32602**

3.7.1 Sediment Flow

The sediment contribution of River Nile at Karuma will be mainly from the catchment between Lake Kyoga and Karuma project site. Studies carried out by various organizations have indicated that contribution of flow to river Victoria Nile at Karuma beyond Lake Kyoga is insignificant and may be received during high flood period only. However, no sediment data downstream of Lake Kyoga has been collected. Thus, the estimated average sediment rate of 8.7 mg/l at Masindi Port and 7.7 mg/l for Tochi River are insignificant.

3.8 AIR QUALITY

Air sampling was conducted in June 2010 at four sites i.e., Dam site, Power house site, Karuma village/center and Karuma Bridge. The parameters studied were Dust PM_{10}, COx, SO_X and NO_X. Results are based on aTime Weighed Average (TWA). The results shows that the COx level at Karuma village and Karuma Bridge were 2.0 ppm and 1.5 ppm respectively while at the dam site and Power house site it was noted Below Detection Limit (BDL). For SO_X and NO_X all the results were Below Detection Limit. All values including Dust PM_{10} recorded were at below the standard level of NEMA, GoU.

3.9 AMBIENT NOISE

Apart from the highways, at Karuma from the Kampala- Gulu and the other junctions to Arua and Lira, there are no permanent roads in the Project area. There are some houses and commercial shops in the Project area along the Highway (Karuma Village/center), Awoo and at Bedmot villages. Noise measurements were taken in June 2010 in the project area at the various locations of the project components. Highest noise levels at both day and night time were recorded as 68.2 and 56.4 respectively at Main Dam and Power Intake area where as lowest as 33.1 and 25.6 at Fuel & Consumables area. All values recorded were below the Standard value of 75 dBA for day and 65 dBA for night.

3.10 TRAFFIC DENSITY

Traffic flow from Kampala to Gulu Highway was observed from morning 8 am to 6 pm evening for 8 different types of vehicles. Maximum flows of vehicles were recorded during 2 to 4 pm and maximum types of vehicle movement were recorded for Wagon.

3.11 WATER QUALITY

Sampling was done on both right and left banks of the river. A total of six sampling sites each at both sides were covered and water samples were analyzed for twenty different water quality characteristics.

The results recorded from both sides did not reveal much difference. Only the E-coli counts from Kampala Beach (3000 colony forming units) and Chobe Lodge (72 colony forming units) were exceptionally higher than the recommended national drinking water standard (0 colony forming unit) as per National Water and Sewerage Cooperation. Cases of decomposing water hyacinth were also noted from Kampala Beach and Opposite/Tunnel Outfow that recorded higher total phosphorus concentration of 0.09 mgL^{-1} and 0.13 mgL^{-1} respectively. However, trophic status of these sites was characterised as mesotrophic in terms of total phosphorus (<0.1 mgL^{-1}) implying that the water quality was good for both domestic consumption and fisheries production. Other than the issue of E-coli and phosphorus concentration at all sampling sites rest of the parameter recorded were below the maximum permissible standard limits.

4.0 BASELINE STATUS OF BIOLOGICAL ENVIRONMENT

Baseline study for the biological environment in the project area was undertaken during the dry season i.e., month of May and June, 2010.

4.1 TERRESTRIAL FLORA

A total of 258 plant species belonging to 61 families were recorded in the project area. The dominant plant family was Fabaceae constituting 15.1% of the total species followed by Poaceae and Euphorbiaceae with 14.3% and 7.8% respectively. Families with monospecies were 29 in included Ulmaceae, Sterculiaceae, Salvadoraceae, Sapindaceae, Sapotaceae, Scrophulariaceae and Myrtaceae. The most abundant tree species included *Albizia coriaria, Albizia grandibracteata, Albizia zygia* while among the shrubs and herbs the most abundant species included *Bidens pilosa, Cynodon dactylon, Hyparrhenia diplandra, Hyparrhenia filipendula, Hyparrhenia rufa, Imperata cylindrica, Indigofera arrecta. Senna spectabilis* were the most abundant alien invasive plant species recorded in the project area.

4.2 TERRESTRIAL FAUNA

Information about the fauna aspect presented has been collected during the field surveys conducted in the month of July 2010 (dry season) using direct and indirect sightings method; transact method and Interaction with the local residents. Result of the faunal survey is briefed as below:

- A total of ninety eight species of butterflies with no species of significant conservation concern were recorded.
- A total of sixteen species of reptiles were recorded with only the Nile Crocodile- *Crocodylus niloticus* being CITES appendix II listed species for Uganda however, it is categorised as Least Concern (LC) according to the IUCN red listing (http://www.redlist.org) while remaining species have not been evaluated yet as per IUCN.
- Thirteen amphibian species were recorded in the study area. All the species recorded are of Least Concern (LC) according to the IUCN red listing (***http://www.redlist.org***) except for *Bufo vitattus* which falls in Data Deficient (DD) category as per IUCN.
- Fifteen species of small mammals and 11 large size mammals were reported from the study area. Of all the species recorded the Elephant and Hippos are considered in vulnerable category as per the IUCN criteria (IUCN 2010).

4.3 AVIFAUNA

Altogether, eighty four species of birds were recorded of which two species namely Brown Snake Eagle and Papyrus Gonolek comes under the regionally near-threatened category while Spot-flanked Barbet, White-headed Saw-wing, Grey-capped Warbler, Golden-backed Weaver and Cardinal Quelea comes under species of regional responsibility are resident breeder.

4.4 AQUATIC ECOSYSTEM

- **Phytoplankton** consists of 86 species belonging to six classes of phytoplankton i,e,. Blue-green algae, Cryptomonads, Diatoms, Dianoflagellates, Euglenoids and Green algae were recorded. Green algae had the highest number of species at 37. Bluegreen algae comprised of 24 species, Diatoms 17 species, Cryptomonads 4 species while Dianoflagellates and Euglenoids registered only 2 species.
- **Zooplankton** community consisted of two crustacean groups; Copepoda and Cladocera (water fleas) and one non-crustacean group; Rotifera. Each of the three broad taxonomic groups was constituted by several genera and species. In general, the zooplankton community of the river section sampled were comparable to those found in most running water bodies in Uganda - associated with poor zooplankton species richness.
- **Altogether 21 Fish species with** no species of conservation importance were recorded during the survey; however, interaction with local fisherman/ communities confirmed that most of the spp. recorded except Haplochromine group, *Brycinus sadleri, Xenoclarias sp and Astatoreochomis spp* were of economic importance to the local community. Out of 21 species were recorded from the study area of which, only 5 species (*Brycinus sadleri, Schilbe intermedius, Schilbe intermedius, Synodontis afrofischeri* and *Synodontis victoriae*) were reported to have migratory nature.

5.0 BASELINE SOCIO- ECONOMIC ENVIRONMENT

Total land required for the project is 465.52 ha out of which 192.75 ha of land is privately owned land which will be acquired from locals residing in four villages i.e., Karuma and Awoo villages located in Mutunda Subcounty of Kiryandongo district and Nora and Akuridia villages in Kamdini sub county of Oyam district. As per the findings of comprehensive surveys carried out for Resettlement Action Plan (RAP), total 414 household are likely to be affected due to land acquisition for proposed Karuma HPP, of which 280 are land owners and 134 are tenants. **Table 5.1** presented below indicates distribution of households that will be affected in the four villages upon execution of Karuma HPP. Total population of these affected household is 3735, of which 50.04 % is male population against 49.96 % females. The average household size ranges from 9 – 10 members.

Table 5.1: Total number of households affected upon execution of Karuma HPP

Village	Total No. of	Total No. of	Total No. of	%age of Total
Karuma	118	93	211	51%
Awoo	154	41	195	47.1%
Nora	6	0	6	1.4%
Akuridia	2	0	2	0.5%
Total	**280**	**134**	**414**	

5.1 AFFECTED SERVICES AND SOCIAL INFRASTRUCTURE

There is no water supply system for the entire project area and the sanitation system is based on pit latrines. The majority of PAPs depend on borehole water. There are three boreholes (two in Awoo village and one in Karuma) that are directly affected by the proposed project. Despite proximity to the river, the river water does not constitute a significant water source even in Awoo village that has a long river bank line.

Apart from it, three telecommunication masts will also be affected belonging to Uganda Telecommunication Limited (UTL), Warid and MTN. The UTL and MTN masts are both located on land belonging to one Bogoro Quinto (himself affected and likely to be displaced) in Awoo village.

6.0. PUBLIC CONSULTATION & PARTICIPATION PROCESS

Public consultation with various stakeholders of local, regional, national and international interests was started in 2010 with objective to introduce the project them and to identify their expectations with respect to the Project and ESIA process. Various departments consulted during the ESIA process were UWA, NEMA, Ministry of Gender Labor and social Development, Ministry of Water and Environment, Ministry of Agriculture Animal Industry and Fisheries and Future Dialogues International. The major concerns raised by the officials are discussed were:

- **Tourism concerns raised by Ministry of Tourism, Trade and Industry &Uganda Wildlife Authority:** The main concern under tourism was visual impacts on the Karuma falls and possible impacts on the downstream wildlife due to the reduce flow.
- **Natural resource management concerns raised by National Environment Management Authority:** Major concerns raised were adequately addressing the river banks and lake shores in the ESIA process and the growing problem of water hyacinth.
- **Biodiversity conservation issues raised by Uganda Wildlife Authority:** Major concerns were impacts due to the flow diversion, De-gazzetement of part of Karuma Wildlife Reserve, Increased Poaching etc.
- **Gender equity and responsiveness concerns raised by Ministry of Gender Labor and Social Development:** Ministry suggested that the local people need to be consulted regarding the project and resettlement process, to explore the options to include local communities in the development process within Kiryandongo and to address gender equity, occupational safety and health in the project design. Further suggestions were orientation and training of

Community Development Staff in social mobilization and to make them part of the project management team and.

- **Water abstraction and discharge issues raised by Ministry of Water and Environment:** Ministry recommended avoiding the diversion water while the Directorate of Water Resource Management recommended for increasing the ecological flow from 50 cumecs to 100 cumecs.
- **Agricultural related concerns raised by Ministry of Agriculture Animal Industry and Fisheries:** Main issue discussed was abstraction of water in Karuma as both the energy and agricultural sectors are competing for the same resource. Committee concluded that the water condition in the upstream of the project will be enhanced.
- **Socio-economic issues raised by nongovernmental organizations:** various NGO's consulted recommended that the design execution of the project should have adequate considerations for environmental like social, cultural and minority groups. The community should be given a chance to access and appraise the project. Government agencies responsible for protected areas should make sure that the area is suitable for the location and also consider community issues at hand.
- **Land acquisition issues by local leadership:** At the time of ESIA study conducted by NORPAK five villages elected a committee to represent the local community. Local leadership recommended that the same structure should be integrated in the new project for the extra land (other than already compensated by NORPAK) to be acquired for the project so that local leaders can sensitize local people. Also, as the compensation rates for Kiryandongo and Oyam are different so these should be considered when undertaking the land acquisition exercise.

6.1 COMMUNITY MEETINGS

The key issues raised by the local community during community meetings are presented in **Table 6.1.**

Table 6.1: Major issues raised by the local community during consultative meetings

Issue	Community concern
Employment opportunities	• A number of youth are engaged in the fishing close to the intake and their livelihoods would likely to be affected therefore they should given first priority during the recruitment exercise. • There is need for entrepreneurship training and provision of loans to the youth so that they can cope with changes in environment.
Utilities and Social Services	• Communities have limited access to safe water and there are few

	boreholes therefore, are need for the communities to benefit from the project for example in Awoo. • Project authorities should support for alternative income generating activities in the area.
Loss of Cultural Resources	• Community members suggested that traditional ceremonies be undertaken before the project begins and there is a need to integrate culture in the planning process.
Grievances	• Most concerns were regarding the compensation and grievance mechanism in order to facilitate arbitration.
Fishing	• Project activities would interfere with the current fishing regimes for community.

7.0 IMPACT ASSESSMENT, EVALUATION AND MITIGATION

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Karuma hydro power project have been identified and appropriate mitigation measures are suggested. The impacts were assessed and evaluated based on the criteria as given below.

Criteria	**Type of Impact**	**Status**	**Duration**	**Intensity / Severity**	**Spatial Extent**	**Likelihood**	**Sensitivity**	**Overall Significance**
Description	Direct Indirect	Positive Negative	Intermittent Temporary Short term Medium Long term	Negligible Low Moderate High	Site Local regional	Uncertain Improbable Probable Highly probable Certain	Low Moderate High	Insignificant Low Moderate High

7.1 IMPACTS ON SOIL AND LAND REQUIREMENTS

7.1.1 Construction Stage

- Increase in soil erosion problems due vegetation clearance and construction activity.
- Mining for the construction material are likely to be sourced from the vicinity of the project area which if carried out inappropriately, scars the land reducing its aesthetic quality, causes erosion and contributes to forest resource depletion.
- Pressure on available land in the area due to increased settlement and cultivation and can easily lead to land degradation if conducted in an unsustainable manner.

Mitigation Measures

- Re-vegetation on slopes and installation of sediment runoff control devices to control soil erosion.
- Procurement of all raw materials and construction inputs from approved sources. In such a case as it may be deemed necessary to open up a new source of material for the project (e.g. for sand), Uganda's environmental legislation requires that a separate environmental project brief be elaborated for each separate material extraction site and the Contractor is required to obtain permits from NEMA for the operation of borrow pits.
- Tree plantation to compensate for the loss of trees and to prevent soil erosion.

7.1.2 Operational Stage

- Submergence is likely to remain confined to river beds only owing to the topography therefore will not have any major impact. However, Atura ferry crossing is also likely to be submerged by the proposed project.

Mitigation Measures

- Appropriate reservoir rim treatment measures comprising of engineering/biological measures.
- EPC contractor will ensure the shifting of Atura ferry crossing.

7.2 IMPACTS ON FLORA

7.2.1 Construction Stage

- Permanent loss of vegetation due to forest clearance. Further surrounding vegetation will experience changes in species composition towards more riparian species.
- Proliferation of invasive alien species including *Lantana camara* and *Senna spectabilis* that were recorded in the project area affecting native or endemic vegetation.

Mitigation Measures

- Conservation of Mvule (*Milicia excelsa*), an IUCN red listed species adopting appropriate in-situ conservation measures.
- Plantation with wildlings of the characteristic species from the nearby areas in the disturbed sites susceptible to erosion.
- Necessary arrangements for community kitchen and provision for free fuel supply to reduce pressure on forest resources.
- Spread of invasive species should be checked as much as possible through uprooting, burning and prevention of growth to reproductive stage.

7.2.2 Operational Stage

- Some plants especially epiphytes including *Cyrtorchis chailluana*, and *Aerangis jkoschyana* on the south bank will be affected due to change in the microclimatic condition due to submergence and reduced amount of spray created by the Karuma Fall.

Mitigation Measure

- No unique plant communities in the upstream and downstream river stretches were identified as being entirely dependent on the microclimate characteristics for their survival.

7.3. IMPACTS ON TERRESTRIAL FAUNA

7.3.1 Construction Stage

- Disturbance to wildlife due to temporary increase in noise and vibration during the construction time.

Mitigation Measures

- Only the necessary roads/buildings should be constructed and the EPC Contractor should avoid opening up unnecessary roads/open spaces;
- Ensure compliance with all regulations relevant to minimizing noise generated from construction.

7.3.2 Operational stage

- Increase human interferences due to improved accessibility will leads to marginal adverse impacts on the terrestrial ecosystem.
- The loss of terrestrial wildlife to drowning during reservoir filling.
- Positive impact on reptilian fauna by providing more rock outcrops and sun basking surfaces for crocodiles and monitor lizards due to the reduced water. The water reservoir upstream the weir will also provide a large feeding ground surface for crocodiles.

Mitigation Measures

- Periodical monitoring of the Nile Monitor and Nile Crocodile species.
- Wildlife rescue efforts shall be taken up, wild animals recued or captured shall be relocated at suitable habitat.

7.4 IMPACTS ON AQUATIC ECOSYSTEMS

7.4.1 Construction phase

- Aquatic ecosystem and biodiversity will be negatively affected due to accidental or deliberate dumping of soil and rock, unprofessional storage and handling of the large quantities of oil and oil products and indiscriminate unsafe disposal of human waste.
- Increased poaching within the Karuma wildlife reserve due to increase in fish demand due to rise in labour population.

Mitigation Measures

- Strict adoption and enforcement of environmental friendly management strategy and practices for soil and rock waste translocation and disposal.
- Safe procedures for storage and handling of oil and oil products.
- Safe waste disposal centres such as latrines accompanied by sensitization on community hygiene not only for the work force but also for the local community.
- Strict enforcement of management strategies that emphasize use of recommended fishing methods and level of fishing pressure would be required to be regulated.

7.4.2 Operational Stage

- The proposed project will lead to drastic drawdown of water level which will cause desiccation of macro-habitats for macro-benthos and young fish; loss of habitats where fish spawn, feed and the very young nursery.
- A large number of hippos will lose suitable diurnal residence/refuge in the existing shallow enclaves of the river.
- Construction of the Karuma Dam will pose restriction to the movement of the migratory fishes reported from the study area.

Mitigation Measures

- Provision of fish ladder apart from the measures taken for the multiplication of the migratory fishes.
- Maintenance of Ecological flow in the downstream to maintain the aquatic diversity.

7.5 IMPACTS ON AIR QUALITY

7.5.1 Construction Stage

- Generation of airborne dust as well as gaseous pollutant as NOx, Sox are likely to increase due to construction activity, increased vehicular movement.

Mitigation Measures

- Use of modern drilling and blasting techniques

- Secondary crushers will be equipped with dust suppression equipment comprising of water sprays.
- A maximum speed limit of 40 km/h will be imposed on all internal access roads by use of speed bumps and appropriate road signage.
- Main access roads in the project area, such as the road from the Kampala-Gulu Highway to the dam and further to the power station will be paved.

7.5.2 Operational Stage

- Emission of greenhouse gases (GHGs) due to decomposition of vegetation submerged by the flooding of the reservoir.
- Modification to the local micro climate due to creation of reservoir which results in a local increase in humidity and a cooling effect. This effect will be intermittent and is not necessarily a negative impact.

Mitigation Measures

- All woody species will be harvested and cleared from the dam basin area and submerged area to be inundated.

7.6 IMPACTS ON NOISE LEVELS

7.6.1 Construction Stage

- Increase in Noise levels in the construction area from machinery and vehicular movement which will have potential impact on construction workers who are working in the close vicinity.
- Increase in vibration level may have negative impact on the land structures like; roads, bridge, house or dam and other components.

Mitigation Measures

- Equipment used, for example, should meet minimum safe guards for natural areas and could have silencers and cause minimum ground vibrations during construction period.
- Blasting activity should be limited or restricted during nighttime and shall be conducted in a controlled manner in accordance with Ugandan explosives regulations.
- Standard occupational health and safety practices such as ear protection and enforcement of exposure duration restrictions should be undertaken.

7.6.2 Operational Stage

- During operation, noise will mainly be generated in the power station, generating units and the transformers which are incorporated with noise reduction facilities and therefore the noise generated will be very low.

7.7 IMPACTS ON WATER QUALITY

7.7.1 Construction Stage

- Siltation of downstream water courses and drainage systems due to increased water runoff and erosion from various work sites.
- Water pollution due to oil and fuel spillages and leakages from transport, storage, dispensing of petroleum products.

Mitigation measures

- Sedimentation control and attenuation facilities such as sand traps, temporary attenuation ponds will be used.
- Stockpile areas for materials and overburden dumps should be located away from water courses.
- Construction of diversion tunnel/coffer dam will be carried out in dry season
- Liquid fuel storage and dispensing on site shall also be provided with relevant standards
- Concrete batching plan/mixing area will be surrounded by a retention bund and excess water will be retained in a sedimentation reservoir.
- Proper disposal of the construction material and hazardous waste.

7.7.2 Operational Stage

- Possibilities of eutrophication due to decomposition of vegetative matter resulting in a nutrient rich environment.
- Growth of aquatic weeds such as water hyacinth, a common problem in other water bodies in Uganda (e.g. Lake Victoria).

Mitigation Measures

- All woody vegetation should be cleared before inundation.

7.8 GEOTECHNICAL SAFETY

7.8.1 Construction Stage

- No major fault / fault zone was located hence the earthquake hazard is not very high for this site.

Mitigation / Enhancement Measures

- The geological condition at the tailrace outfall area is not suitable to drive the tunnels up to the river, so a trapezoidal channel of 100.0 m base width with 1:1 side slope has been proposed at 8.3km downstream of surge chamber.
- Establishment of a seismicity monitoring station.

7.8.2 Operational Stage

- Studies conducted by NORSAR (Norway), for NORPAK in 1999, revealed that earthquake hazard is not very high for this site. But it is still not negligible, and will depend on project characteristics. Further information regarding the seismic risk assessment is given in the Engineering report.

Mitigation / Enhancement Measures

- Establishment of a seismicity monitoring station.

7.9 IMPACTS ON OCCUPATIONAL HEALTH AND SAFETY

7.9.1 Construction Stage

- Potential high risk levels to the occupational health and safety of workers and personnel during deep excavations work and handling of heavy plant and machinery.
- Risk of fire due to negligence

Mitigation Measure

- EPC Contractor shall be obliged to comply with the Health and Safety Regulations of MEMD as well as with all applicable Ugandan construction Health and Safety Standards as required by the Occupational Safety and Health Act of 2006.
- Provision of Fire prevention systems.

7.9.2 Operational Stage

- Accident and injury can result during operation of high voltage equipment / risk of electric shock, operation of mechanical moving equipment (turbines and generators) and fire/heat hazards (apply to every aspect of the plant and in particular electrical systems and handling of fuels).

Mitigation Measures

- All employees should be trained and inducted in the company's safety rules and regulations such as use of personal protective equipment (PPE), Fire procedures and assembly points etc.

7.10 IMPACTS ON PUBLIC HEALTH AND SAFETY

7.10.1 Construction stage

- Reduced road safety on the Kampala—Gulu Highway road around Karuma due to construction traffic.
- Increased risk of transmission of HIV and communicable diseases due to social interactions amongst the construction workers and local communities.

Mitigation / Enhancement Measures

- Speed limit signs, traffic and safety barriers and other relevant warning signs will be established in and around construction sites and access routes.
- Awareness campaigns on traffic safety will be organized.
- An intensive HIV/AIDS awareness programme should be organized in association with the Kiryandongo Hospital, District Aids Coordinators, Uganda AIDS Commission.

7.10.2 Operational Stage

- Increased risk of waterborne diseases due to the formation of reservoir which will provide breeding ground for malaria and bilharzias.
- Risk of drowning due to formation of reservoir and at the event of dam break/failure

Mitigation Measure

- Health campaigns regarding diseases such as malaria and bilharzia will be conducted.
- Distribution of treated mosquito nets to all residents surrounding the dam area will be promoted.

7.11 IMPACTS ON SOCIAL ENVIRONMENT

7.11.1 Construction Stage

- Population increase due to immigration of labour population.
- Change in settlement pattern in the Karuma area as some villages in the dam site will have to be relocated from the intake area

Mitigation / Enhancement Measures

- Strict control to in-migration should be instituted to ensure only relevant staff move to the construction site area.
- Involvement of local authorities in the regulation and control of any influx of people into the area.
- A Resettlement Action Plan (RAP) has been developed; this also will include a Community Development Plan (CDAP) which has been developed taking into account the ongoing local government programmes and interventions in the project area and its immediate environs.

7.11.2 Operational Stage

- Physical displacement and loss of fixed family assets in the four affected villages.

Mitigation / Enhancement Measures

- An adequate compensation package will have to be developed in close collaboration with all stakeholders, as part of a Resettlement Action Plan (RAP).
- Local Area Development plan should be developed by Government within the framework of decentralized district planning, in collaboration with relevant stakeholders.

7.12 VISUAL IMPACTS

7.12.1 Construction Stage

- Alteration in the normal visual impressions in the Karuma Wildlife Reserve & Murchison Falls National Park due to vegetation clearing and construction of the project.

Mitigation / Enhancement Measures

- Unnecessary lighting at worksites will be avoided.

7.12.2 Operational Stage

Scenery of the Karuma Falls will be impacted on due to the reduced water flow over the falls. This impact will be long term.

Mitigation / Enhancement Measures

- Environmental Flow Releases (EFRs) from the dam intake will to some extent serve to maintain natural flow variations in the river.

7.13 IMPACTS ON CULTURE AND HERITAGE RESOURCES

7.13.1 Construction Stage

- Total distraction of the archaeology and other cultural resources found in the soils like burials due to construction work.
- Vibration from construction vehicles poses threat to the physical fabric of the pottery, iron slag, furnaces, tuyeres and the bone remains

Mitigation / Enhancement Measures

- Rescue archaeology for site of test pit 1 before construction and more research and documentation of sites is needed especially during construction.
- Relocate the shrines and ritual site in accordance with laws and local traditional norms.

7.14 COMMUNITY/NATIONAL BENEFITS

7.14.1 Construction Stage

- Boost to the Local Economy due to increase in market demand of food and other necessities.
- Employment opportunities will be created for both skilled and non skilled labours.
- Capacity building will be provided (organised and un-organised) through the transfer of new technologies and new skills to (un-skilled) labour.

Mitigation / Enhancement Measures

- Market opportunities / infrastructure for the sales of local produce to the workforce will be provided.
- Programmes and technical training courses as well as on the job training will be provided in specific skills areas for suitable candidates.

7.14.2 Operational Stage

- Increase in revenue and taxes for both the central and local authorities
- Increased installed capacity for electricity generation
- Improved local infrastructure/facilities due to upgrading of the access roads
- Implementation of this project will have a positive impact in a number of ways, including improved infrastructure such as the access roads and improved security in the area, it is likely to affect tourism activities especially the fishing concession given to Chobe Lodge.
- Positive impact on Agriculture due to more reliable water supply from the reservoir.

Mitigation / Enhancement Measures

- Establishment and or improvement of local social infrastructure such as schools, health facilities and water points will be established under the RAP process (See RAP Report Vol IV).
- EPC contractor in association with the UWA will do the monitoring in order to avoid any negative impact on the KWR.

7.15 ENVIRONMENTAL IMPACTS OF DECOMMISSIONING

Decommissioning of dam can have following negative impacts:

- Downstream sediment impacts and change in aquatic ecology
- River channel instability and hydrological alterations
- Air pollution due to emissions of dust and other Green House Gases GHGs
- Temporary increase in noise and vibration due to blasting
- Socio-Economic impacts due to removal of dam structure being in term of alternative energy source or due to damage of land use.

Mitigations

- Complete or partial removal of sediment behind the dam, combined with stabilizing the sediment by engineered measures or vegetation covers.
- Decommissioning should be undertaken in accordance with the legislation prevailing at that time, in liaison with the relevant regulatory authorities and adhere to the dam safety guidelines.
- Safe disposal of concrete and similar non-recyclable construction materials, restoration of all disturbed sites to pre-construction conditions through bio-engineering measures.

7.16 CUMULATIVE IMPACTS

According to the Hydropower Master Plan of Uganda, seven hydro power projects are proposed in the downstream of Bugajali hydro power project which is already under construction. Most of these projects are contemplated as Run of the River (ROR) scheme projects (Table 7.1).

Table 7.1: Considered projects for cumulative impact assessment

Project Name	Project Type	Progress
Kalagala	Hydropower(330MW)	None (stopped by Kalagala offset)
Isimba	Hydropower(138MW)	Feasibility Study
Karuma	Hydropower(576MW) *	Feasibility Study
Oriang	Hydropower(392MW)	None
Ayago	Hydropower(612MW)	Pre-feasibility study
Kiba	Hydropower(288MW)	None
Murchison	Hydropower(648MW)	None

*Current design proposal for Karuma is 600MW

Summary conclusions with respect to Karuma

Environmental issues for the Karuma HPP (without considering cumulative effects) are minor or moderate and should be acceptable in consideration of the power benefits. Development of Karuma HPP in conjunction with other hydroelectric projects on the Victoria Nile would have a moderate negative cumulative impact on the aesthetics and natural heritage of the country. The Karuma Falls are not a big tourist attraction at the moment due to inaccessibility, but clearly have tourism potential. However, Karuma Falls are not suitable for white water rafting; the KFHP does not contribute to cumulative impacts with respect to such tourist activities.

7.17 TRANSBOUNDARY IMPACTS

In view of the fact that Karuma Hydropower Project is situated in the interior of the country, not sharing borders with any of the riparian country and based on the impact already discussed under cumulative impacts hardly any transboundary impact are predicted for proposed Kruma HPP.

8.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN (EMMP)

Environment Management & Monitoring Planning (EMMP) converses all aspects of planning, construction and operation of the project, which are relevant to environment and is divided into measures to be implemented under the physical environment, biological environment, socio-economic environment and Cultural & Archaeological Environment. Plan allocates the responsibilities for implementation of the proposed mitigation measures to the various stakeholders.

The persons and institutions responsible for implementing the plan will include the EPC Contractor, The Ministry of Energy and Mineral Development (MEMD), Uganda Wildlife Authority (UWA), National Environment Management Authority (NEMA), Directorate of Water Resources Management (DWRM), Uganda National Museums (UNM), Chief Government Valuer (CGV), Districts (Kiryandongo and Oyam) and the Local Authorities.

Monitoring is recommended in the context of ensuring that ecosystem function is maintained at a level equal to or better than pre-construction conditions. The Hydropower Development Unit in MEMD, and where required, external consultants and other Government Agencies, will undertake to monitor various components of the project. All environmental monitoring programmes shall be undertaken under the supervision of the National Environment Management Authority (NEMA), Uganda Wildlife Authority (UWA) and the respective Districts. This will ensure compliance to the environmental mitigation plans during construction, operation and maintenance of the hydro power infrastructure. The scope and responsibility of the main stakeholder responsible for implementing the plan i.e., The Ministry of Energy and Mineral Development MEMD and EPC Contractor are discussed as follows:

Role of EPC Contractor

a. Review the approved ESIA document, particularly the required mitigation measures and the environmental management and monitoring plans, and the owners environmental and social management framework;

b. Review approval conditions provided by NEMA (approval certificate), and permits from lead agencies;
c. Preparing a Contractor Environmental, Social, Health and Safety Action Plans to comply with the above requirements including an implementation framework, including staffing and budget.
d. Consult general public and disclose information in relation to construction scheduling, traffic management, public health and safety, and the results of Environmental monitoring.
e. All expenditure and costs related to complying with Environmental safeguards as applicable to construction and development of Karuma HPP would be met by the EPC Contractor.

Role of Developer (MEMD)

The Developer will monitor compliance of the Contractor through its implementation agency, and a stakeholder wide monitoring group comprising technical staff from government institutions (NEMA, MEMD, UEGCL, UETCL, ERA, MWE, DWRM, DWD, MoWT, MoGLSD, UWA, MTTI, Ministry of Lands, Housing and Urban Development etc) and Civil

8.1 SOCIAL & ENVIRONMENTAL MANAGEMENT PLAN FOR KARUMA HPP

Social and Environmental Action Plan is an umbrella plan that is comprised of several components that are to be integrated and implemented by project developer and the EPC Contractor with regard to the proposed Karuma Hydropower Project. This introductory section to the SEAP will include all the relevant policies, regulations, procedures arising from government agencies, lender policies and international treaties which have to be followed during the construction and operation of this project. These relevant policies and guidelines will have to be observed to reduce environmental (including social and economic) impacts of the project. The Management Framework will include a Change Management process, whereby proposed changes to social and environmental management procedures are reviewed and assessed prior to their implementation.

8.2 ENVIRONMENTAL MONITORING & AUDITING

During project implementation, a framework in the form of a plan is proposed to ensure efficient and effective undertaking of the mitigation measures. Environmental monitoring is used as a tool in relation to environmental management as it provides the basis for rational management decisions regarding impact control. By using the information collected through monitoring; environmental mitigation and benefit enhancement measures can be improved and the works or operation will be modified or halted when necessary.

The proposed environmental monitoring programs shall include:

a) Compliance monitoring
b) Baseline monitoring
c) Environmental effects monitoring

8.3 INSTITUTIONAL STRENGTHENING

Several governmental agencies at both the local and national levels will be responsible for ongoing monitoring of construction and operational conditions and activities. MEMD will consult with the applicable agencies to establish the extent of each agency's 'in house' capability for managing such activities, and identify any shortfalls. Wherever appropriate, institutional strengthening should be integrated with existing programs being planned or implemented by the institutions themselves, or by national or international organisations such as NGOs.

The general process to be followed to establish institutional strengthening needs is as follows:

- Discuss the mandate and monitoring responsibilities of each agency, and develop a monitoring plan that will include details of procedures, equipment requirements and staff requirements;
- Establish the Agency's 'in house' capability for managing such activities, and identify any shortfalls;
- Develop, in consultation with the Agency, a plan for meeting these shortfalls;
- Assist the Agency to implement a specific capacity building plan, taking into account other capacity building programs being planned or implemented by government or international organisations; and,
- Monitor the effectiveness of institutional strengthening measures, and carry out any further measures as required.

The agencies responsible for the monitoring of construction and operational conditions and activities of Karuma HEP are UWA, EPC Contractor, DWRM, NEMA, District Health Offices, UEGCL, MoW/UNRA and District administration.

8.3.1 Permits and approval conditions

The environmental monitoring reports will be provided timely by the responsible agencies. These reports allow in identifying if any mitigation measure is not being effective and will enable corrective action to be taken. These documents may be inspected and/or audited by NEMA and other stakeholders and project lenders from time to time, in accordance with the above statute. This will provide an

opportunity for them to comment both on the impacts of the project itself and the efficacy of the ESIA. A limited number of hard copies of the quarterly reports will be made available to local stakeholders at the project developer's offices. All monitoring and reporting documents will be kept on file for the life of the project, and will not be disposed of without permission from NEMA.

8.4 ENVIRONMENTAL MITIGATION BUDGET

Summary of various budgeted provisions for mitigation activities and monitoring plan with related costs are outlined in **Table 8.1** given below while the budget related to the socio-economic issues is provided in the Resettlement Action Plan (RAP).

Table 8.1: Summary of costs in implementing the EMMP

S. No.	Mitigation measures	Tentative Cost, USD
1	**EMP at Construction Site**	**8,200,000**
a	Muck Management Plan	2,500,000
b	Landscaping & Restoration Plan	800,000
c	Erosion & sediment control	3,000,000
d	Solid waste management and sanitation	1,000,000
e	Pollution control	100,000
f	Dam Safety and Emergency Response Plan	800,000
2	**EMP for Biological Resources**	**3,000,000**
a	Wildlife and Biodiversity Management plan including plan for National Park	1,300,000
b	Fisheries Management Plan	700,000
c	Greenbelt development Plan	1,000,000
3	**Management Plan for Human Issues**	**5,000,000**
a	Electricity Supply	1,000,000
b	Strengthening of health services	1,000,000
c	Improvement of Educational Facilities	1,500,000
d	Employment opportunities	1,500,000
4	**Health and safety management plan**	**100,000**
5	**Labour Force Management Plan**	**400,000**
6	**Management Plan for Resettlement**	**1,000,000**
7	**Best Management Practices in agriculture**	**420,000**
a	Improved inputs for seeds, fertilizers and equipments	50,000
b	Improvement of veterinary health services	20,000
c	Agricultural Centre	300,000
d	Training to the farmers for best practices	50,000
8	**Management Plan for Cultural Heritage**	**800,000**
9	**Institutional Strengthening**	**800,000**

10	**Environmental Monitoring Programme**	**800,000**
11	**Tourism**	**1,20,000**
Grand Total		**20,520,00**

Note: The cost of the resettlement and compensation as evaluated by Chief Government Valuer is provided separately in Volume III Resettlement Action Plan (RAP) of ESIA. However, the above cost estimated for Management and Monitoring may consider as tentative which may revise in future as per need.