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Ethiopia-Sudan Power System Interconnection ESIA

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SMEC

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Ethiopia-Sudan Power System Interconnection
Environmental and Social Impact Assessment
Final Report

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Abbreviations/Definitions

BP	Bank Procedure of the World Bank
Bildat	Small-scale farm allotment (Sudan)
CBO	Community Based Organisation
EEPCO	Ethiopian Electricity and Power Corporation
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
EPA	Environmental Protection Authority (Ethiopia)
EWNHS	Ethiopian Wildlife and Natural History Society
Hafir	An artificial reservoir excavated manually or mechanically, often in clayey areas, used as a water supply for communities
IAPs	Interested and affected parties
IDEN	Integrated Development of the Eastern Nile
Kebele	Smallest Administrative Unit (Ethiopia)
Khors	Water course
kV	kilo volt – 1,000 volts
Nazara	Traditional (Native) Administration (Sudan)
NBI	Nile Basin Initiative
NEC	National Electricity Corporation (Sudan)
NGO	Non Governmental Organisation
OP	Operational Policy of the World Bank
PAPs	Project Affected Persons
PCBs	Polychlorinated biphenyls is a persistent organic pollutant (hazardous waste) once added to transformer oils
Omda	District Level Government Administrative Division (Sudan)
RAP	Resettlement Action Plan
RFP	Request for Proposals (RFP No. ENTRO-IDF-003/04)
ROW	Right of Way
TOR	Terms of Reference
Wali	State Governor, Sudan
WB	World Bank
WNHS	Wildlife and Natural History Society of Ethiopia
Woreda	Rural Town and Local Government Administrative Division (Ethiopia)

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Executive Summary

Background

The Ethiopia-Sudan Transmission Interconnection Project is being implemented under the Nile Basin Initiative under the supervision of the Eastern Nile Technical Regional Office (ENTRO) representing the Eastern Nile countries of Ethiopia, Egypt and Sudan. The Project forms part of the Program on Integrated Development of the Eastern Nile.

Project Description

The Project involves the construction of a high voltage transmission line from Ethiopia to Sudan to utilise surplus hydropower from Ethiopia to replace oil-based thermal generation in Sudan. The interconnection would also provide benefits of common reserves in emergency cases (electricity could be transferred from Sudan to Ethiopia under severe hydrological conditions in Ethiopia) and achieve considerable savings in timing of power plants in the long run. Three alternative routes are being investigated. These routes pass through the Amhara, Oromiya and Benishangul-Gumuz Regions of Ethiopia, and the Al Qadarif (El Gedaref) and An-Nil al-Azraq (Blue Nile) States of Sudan. The recommended route (Option C) is approximately 446 km in length, starting from Bahir Dar in Ethiopia and connecting to the El Gedaref Substation in Sudan via the border towns of Metema and Gallabat. This has been considered by the Project's Feasibility Study as the most cost effective of the three Options.

Option C route includes construction of a new single circuit line between Bahir Dar and Gonder (Azezo) running parallel to an existing single circuit line, construction of a second circuit using the same towers under construction by EEPCO for a single circuit line between Gonder and Shehedi, construction of a new double circuit 230kV line from Shehedi to Metema/Gallabat and on to Gedaref in Sudan.

The Consultancy Services for this report requires the preparation of an ESIA and two RAP reports (one for Sudan and one for Ethiopia) in accordance with the requirements of the Ethiopian and Sudanese Governments and the World Bank which has provided funds towards this investigation. The Project has been classified as a category "B" project under the Bank's environmental procedure (OP/BP 4.01 Environmental Assessment) so that an ESIA (including an Environmental Management Plan) and Resettlement Action Plan (RAP) are required.

ESIA Methodology

The Consultant was based in offices in Ethiopia (Addis Ababa) provided by ENTRO under the supervision of the PCU and also established an office in Sudan (Khartoum) to facilitate completion of the work initially within the four month timeframe (August to November, 2005) for the preparation of the ESIA and RAP reports. Although separate Teams of domestic specialists (including socio-economic and bio-physical expertise), each managed by a senior international expert with extensive experience in ESIA and RAP studies were established, the arrangement was flexible to allow interchange of staff between the Teams to maximise available expertise in the short time frame for completion of the studies. The original term of the consultancy was increased by 1.5 months to allow completion of RAP reports for sections of the Option C route which were surveyed in early 2006. These sections were Bahir Dar to Gonder (Azezo) and Shehedi to Metema in Ethiopia and Metema/Gallabat to Gedaref in Sudan.

The ESIA builds on previous environmental and socio-economic studies completed in 1995 since the current proposal contains similar route options as the previous study. A more in depth investigation of the bio-physical and socio-economic environment was undertaken for the preferred route (Option C) from Bahir Dar in Ethiopia to Gedaref Substation in Sudan.

The services of a local ecologist and plant taxonomist were used to describe vegetation types, species composition and biodiversity; list any endangered, rare or vulnerable species; assess their ecological importance and assess impacts from the Project and develop appropriate mitigation measures. Socio-economic information for this route was obtained from the RAP study through detailed household inventory/census of Project Affected Persons and local administrative authority interviews.

Methodology for Route B1/B2 was less intensive (because of time, access and resourcing limitations) but of a sufficient level to allow detailed comparison of the route with that of the

preferred Route C. Bio-physical information was collected using a similar methodology used for Option C. Socio-economic information was based on sample household surveys.

For the alternative route Option A, the investigation used a rapid appraisal technique of bio-physical resources which: characterised the biological resources within the area of Project intervention; identified environmentally sensitive areas and assessed the likely affects from construction and operation of the transmission line and associated structures; and identified mitigation measures to avoid or lessen the negative impacts. Socio-economic information was obtained from the RAP study through a general socio-economic survey of the route which included selective interviews/meetings with local and regional administrative authorities.

Public disclosure of the ESIA will be based on the Ethiopian and Sudanese Environmental Protection Agency requirements as well as the World Bank Operational Policy on Disclosure (OP 17.50). Public consultation has been implemented through the RAP process which made extensive use of local administrative units (Woreda and Omda), interviews with Project Affected Persons, regional authorities and relevant NGOs.

Description of the Environment

Physical/Biological

The topography along the preferred route from Bahir Dar to Gedaref varies greatly from the high plateaux area above 1500 m around Gonder to the lowland plains (around 300 to 500 m in altitude) towards the Ethiopian-Sudanese border at Metema and then on to Gedaref in Sudan. The climate is tropical where there is no significant variation in day length and the angle of the sun throughout the year. Temperature and rainfall is influenced strongly by the topography with the highlands experiencing cooler temperatures and higher rainfall than the lowlands which on the Ethiopian side of the border lies in a rain shadow from the highlands.

The region lies within the catchment of the Abay or Blue Nile River and many of the watercourses flow only during the rainy season from May/June to September/October. Access to potable (drinking) water supplies is often a problem during the dry season especially on the lowlands in Sudan and in Ethiopia near the border with Sudan. Local villagers rely on groundwater wells and small dams (wadis and hafir in Sudan) for water supply during these times.

Shallow stony soils are commonly found on the plateaux areas and on hilly areas within the lowland plains while black cracking clays dominate the lowland plains, particularly in Sudan. Although the black soil types are good for cropping, they make access to the area during the wet season very difficult. Soil erosion/degradation is a major problem such that it contributes to the low level of agricultural productivity in Ethiopia and increasing desertification in the Sudan.

Land use and vegetation cover have been strongly influenced by the climate, topography and population. Few if any undisturbed natural forests remain, most have been heavily disturbed and degraded. Forest types along the Project Route include natural forest, plantation forest, farm forest and Acacia woodland/savannah.

Land clearing, land degradation and large stock numbers have also adversely affected the area's biodiversity and although vegetation types are diverse, they are severely degraded. Similarly, the area's wildlife diversity has been significantly reduced, especially with respect to the larger mammals. The diversity of bird species has also been reduced though many endemic species (occurring nowhere else) still occur in Ethiopia.

Community Ethnicity

The main ethnic group in the Amhara Region is Amhara, with minor representation of the Weto, Hemra and Agew. In the Oromiya Region, the major group is Oromo, with minor representation of Amhara, Gurage and other smaller groups. In the Benishangul-Gumuz Region, the Gumuz, Berta, Oromo and Amhara people can be found. The majority are Amharigna and Oromiffa speakers, although other languages are also spoken. The major religious affiliations are Christianity and Islam.

By contrast, the ethnic profile of east central Sudan is extremely diverse. The two States are inhabited by a mix of sedentary agriculturalists, and nomadic or semi-nomadic pastoralists. Amongst the latter category are also the Ingessana, Falatta and Umbararo ethnic groups who originate from Nigeria, and the Dinka who more recently, have sought refuge in the area from the

war in southern Sudan. Although Sudanese Arabic is spoken by most people throughout these two States, the area is remarkable for its linguistic diversity. While the majority are adherents to the Moslem faith, Christianity and a range of indigenous spiritual traditions are also practiced.

The population in the area is predominantly rural with an agricultural base. The majority of Ethiopians and Sudanese in the Project affected areas are dependent upon land as the basis of socio-economic subsistence. Mixed farming prevails with crop and livestock husbandry often practised under the same management unit. Farming technologies differ greatly between Ethiopia and Sudan. In Ethiopia, farming technologies are largely smallholder subsistence based with low productivity while in Sudan farming technology is predominantly mechanised and rain-fed with higher productivity.

Industry and Infrastructure

Infrastructure and basic services are very poor throughout the Project area and there are few all weather roads. Option C Route follows a major road transport link between Ethiopia and Sudan, but even this route is not always passable during the wet season. Buses run between larger towns/villages and larger urban areas are also serviced by minibuses and taxis.

Industry is mainly based on crop processing and includes cotton mills, sugar, vegetable oil and leather works.

Housing

The quality of housing in the Project affected areas is low. The majority of rural people live in wood and mud houses with thatched roofs that give shelter to both people and their livestock. The current stock of urban housing - most of which are constructed from corrugated iron sheeting – is also insufficient and of very poor quality. A census taken in Ethiopia in 1994 indicates that some 70% of the houses comprised only one room and a considerable proportion of the dwelling units are shared by more than one household (Amhara Conservation Strategy, 1999, vol. 1).

Education and Literacy

Education and literacy levels in the Project affected areas are generally low. For instance, the Education Bureau of Amhara National Regional State (1999) estimated that only 13% of school-aged children attend school, and between 40-50% of the total population is unable to read or write.

Non-formal education, which is an essential component of the integrated rural development process, has only been administered in the Project affected area in the last few decades.

Water and Sanitation

As with related infrastructures, the provision of domestic services such as water and sanitation in Project affected areas is very low. Problems related with scarcity of drinking water supply and adequate sanitation services prevail to an immense degree. In the Amhara Region, only 10.3 % of urban dwellers receive clean water from properly constructed facilities (Amhara Conservation Strategy, 1999, vol. 1.) In the rural areas, this situation is far worse.

Women are the principle collectors of water and are responsible for family hygiene. In some places they travel distances as far as 5-7 km to acquire water for drinking and cooking.

Basic facilities for both solid and liquid waste disposal are almost entirely lacking. Many urban houses are without appropriate sanitation facilities and there are few public toilets. Poor sanitation has adverse effects on community health. Sanitation in rural areas is almost non-existent.

Food Security

Environmental problems in both Ethiopia and Sudan are experienced predominantly in the form of deforestation and soil erosion. In Sudan, mechanized farming has been particularly responsible for the depletion of biodiversity. Environmental degradation throughout the Project affected area is considerable, exacerbated by population growth, and centuries of cultivation and abuse of natural resources.

The major problem of food security in Ethiopia, particularly amongst poor farmers and farmers in marginal areas, is the lack of agricultural development and extreme vulnerability to drought. Over-population and the lack of irrigation and food storage infrastructure increase the risk of famine. Water harvesting and the development of small-scale irrigation would mitigate the impact of

rainfall vulnerability or absence. In addition, food security would be mitigated through livestock development by way of improved breeds, veterinarian services and enhanced livestock marketing.

Poverty reduction programmes in both countries confer that agriculture and rural development requires complementary and simultaneous development initiatives in non-agricultural sectors. Education, health, water supply, road and transport services, and small and medium industries development is considered critical for rural transformation and national development.

Heritage

Much of the heritage and culture in both Ethiopia and Sudan is under threat through neglect, decay, removal or destruction as well as through the less visible and tangible impacts of changing socio-cultural values. Field inspections and secondary data sources suggest that there is unlikely to be any significant cultural heritage items along Ooption C route and there are no known tourist locations in the vicinity which would be affected by the Project.

Environmental and Social Impact Assessment

An assessment of the social and environmental impacts associated with the Project based on field inspections and literature sources indicates that most impacts associated with the Project are of a temporary nature resulting during construction and can be minimised by good engineering practice and implementation of appropriate safeguards as outlined in the EMP.

The biophysical impacts of the Project utilising the Option C route from Bahir Dar substation in Ethiopia to Gedaref substation in Sudan are expected to be minimal and short term. The preferred route does not pass through any conservation reserves or protected forest areas although there are known bird migratory routes and important bird areas adjacent to the Bahir Dar to Gonder section. The proposed alignment of the transmission line is over 5 km from the core important areas within the Forgera Plains and there is already an existing single circuit line passing through the area. The addition of another line is not expected to significantly affect the important bird area. Much of the vegetation along the route has been disturbed by mixed subsistence farming in Ethiopia and mechanised rain-fed agriculture in Sudan such that there is unlikely to be a loss in biodiversity of plants or vegetation communities.

Because of the linear nature of a transmission line development, it is concluded that the Ethiopian-Sudan Power System Interconnection Project will have minimal impact on communities or persons, and on private or common property assets. However, compensation will be due where towers or Project right-of-way (ROW) affects residential dwellings or social services (which will pose health and safety problems); will fragment cultivated fields and compromise productivity and income; will involve the removal of fruit-bearing trees and other economically valuable natural resources, or may partially or totally disturb cultural properties such as churches, mosques, or archaeological sites. Although the Project will have minimal impact upon PAPs, site-specific relocation may have to occur where access routes, line corridors or transmission towers are to be located.

Project impact is anticipated to occur predominantly during the construction phase with the importation of skilled workers into the area, and the construction of work camps and temporary access roads and establishment of the transmission line ROW. While major attention will be focused on loss of income due to temporary disturbance to crops or grazing areas, and on health conditions related to the influx of workers from outside the region (HIV/AIDS being the major concern), positive opportunities to PAPs may be presented in the form of temporary employment, as well as through income generated by the sale of food to immigrant workers. For the most part, however, compensation is expected to be characterised by a large number of small payments for the temporary loss of assets.

According to World Bank OP 4.12, a resettlement plan or a resettlement policy framework is required when a project results in the involuntary loss of land or other assets including the loss of income sources or means of livelihood. Due to the high estimation for resettlement made in the 1995 Feasibility Study, the World Bank rated the Project a Category B project requiring a RAP. The Consultant has concluded that some 307 dwellings will be permanently affected on Option C (recommended route) however relocation within the same vicinity will be possible for all people required to be moved. On Option B, more than 330 dwellings are likely to be affected.

The Table below presents a summary of the environmental and social impact assessment for the routes considered in this study including the recommended Route (Option C) based on information

gathered during the ESIA and RAP studies. For the most part, the impact is expected to be temporary and acceptable through implementation of appropriate mitigation measures. Since EEPCO is constructing its single circuit line along the Option C alignment between Gonder and Shehedi, it is expected that the Ethiopia-Sudan Power System Interconnection Project will exact minimal additional impact on affected communities and the environment beyond the construction phase.

TABLE 1. SUMMARY OF ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Impact	Option A (614km)	Option B1 (448km)	Option B2 (425km)	Option C (446km)
Permanent loss of land to estblishment of towers (ha)	6.13	4.3	n/a	4.48
Temporary loss of land during establishment of ROW (ha)	2,456	1,353	n/a	962
Replacement of thermal generated power with hydropower, reduction in greenhouse gas emissions and other air pollutants	+++	+++	+++	+++
Increased reliability of power supply in Sudan	+++	+++	+++	+++
National economic benefit in Ethiopia and Sudan	+++	+++	+++	+++
Construction of temporary and permanent access roads leading to transmission alignment, tower sites and substations	--	-	-	-
Temporary Increased traffic due to transportation of construction and operation personnel and machinery	--	-	-	-
Site levelling and development	-	-	-	-
Clearing of vegetation in the Right of Way (ROW) and associated impacts on land use	--	-	-	-
Relocation of existing households from the site	-	--	--	-
Loss of protected forests/conservation areas/rare plants	unlikely	-	-	unlikely
Loss of endemic/migratory bird species	unlikely	-	-	unlikely
Loss of forests / economically valuable trees	---	--	--	-
Compensation for permanent loss of land or temporary loss of income	--	--	--	-
Temporary Construction traffic leading to increased traffic and safety issues for road users	-	-	-	-
Air and dust emissions during construction	-	-	-	-
Noise level during construction and operation phases	-	-	-	-
Changes in stormwater runoff due to clearing or grading, tower construction	-	-	-	-
Loss of aesthetic value	-	--	--	-
Decommissioning and disposal of substation and equipment	-	-	-	-
Health effects of electromagnetic fields (EMF) of high voltage power transmission lines outside the 40m ROW	-	-	-	-
Opening of remote lands to human activities, such as settlement, agriculture, hunting, recreation etc.	unlikely	unlikely	unlikely	unlikely
Safety issues arising from low-slung transmission lines or lines near human activity, e.g. buildings, roads	-	-	-	-
Hazards to low flying aircrafts	-	-	-	-
Cultural and interpersonal impacts of workers brought in during the construction phase	--	-	-	-
Possibilities for local employment during construction or operation	+	+	+	+

+ minor positive impact ++ medium positive impact +++ major positive impact

- minor negative impact -- medium negative impact --- major negative impact

Environmental Monitoring and Management

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 Ethiopia and Sudan. To ensure the effective implementation of the EMP 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.

An outline of an Environmental Management Plan (EMP) has been included in this ESIA Report to indicate the range of environmental impacts/issues and associated mitigation measures envisaged for this Project. The EMP also identifies responsibilities for implementing the mitigation and monitoring measures.

Conclusion

Based on detailed field work for the preferred route, secondary data sources and consultations with Project affected people, local, regional and national government agencies and other organisations it is unlikely that the Project will have significant adverse social and environmental impacts. Most 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.

Option C from Bahir Dar in Ethiopia to Gedaref Substation in Sudan is the preferred route for the following reasons:

- Option C is considered the most cost effective of the three route options;
- It is much more accessible, more secure with high levels of traffic movement;
- The route has been under much more human development compared with Route B; it has been tampered with for centuries (Ethiopian and Sudanese history asserts this fact); hence additional impact is unlikely to cause further decline;
- The ecological mitigation measures suggested are more manageable in Route C, where:
    - Diversity sites are either extensive or absent all together (for example relatively more extensive gum Arabic trees (*Boswellia payrifera*) compared with Metekal;
    - Lowland bamboo in situ conservation sites are found along Routes B and A but not C;
    - A new species of herbaceous plant (*Chlorophytum serpens*) was discovered along Route B only a year ago (Sebesebe Demissew *et al*., 2005). It was not recorded along Route C;
    - Even though endemic trees were observed along all alternative routes, there were more rare species along Route B than C; for example the endemic Araliaceous tree species *Cussonia ostinii*, was only observed 28 km from Mankush towards Chagni at 11° 18’59.1”N and 35°31’38.2”E at 940 m.
- It is located in regions of Ethiopia and Sudan where there is scattered inhabitation and where there will be nominal impact to PAPs;
- No major resettlement will have to take place; households affected by the route will be shifted either to a different section of a property or within the vicinity, thus minimizing disruption to social and economic networks that are relied upon by families and individuals;
- Fewer female-headed (vulnerable) households will be affected on Option C than on the other routes;
- In Ethiopia, the transmission line will be linked to local electricity infrastructure that will provide separate, but complementary tangible Project benefits to PAPs;

- In Sudan, local electricity supply is available to part of the proposed route. The Consultant recommends that the Project set aside some budget to see to the completion of the single line circuit, thus ensuring that local villages can benefit from the Project;
- The transmission line will build upon a comparable roads and local electricity infrastructure in Ethiopia and Sudan, thus supporting the notion of an inclusive Project profile, built upon trans-boundary partnerships and exchange.

Poverty Alleviation

Ethiopia and Sudan have amongst the lowest levels of electricity generation per capita in the world. For example, in Ethiopia, only 13% of the population has access to electricity (Ethiopia: Sustainable Development and Poverty Reduction Program, 2002).

Electricity is essential to the development of agro-processing industries, commercial enterprises and irrigation facilities in the rural areas. The Consultant believes that by providing local electricity to PAPs - either directly through the financing of local distribution lines, or indirectly, by reinvesting a proportion of the economic benefits of the Project into rural electrification - the Project will be enhancing overall poverty reduction and rural development efforts in the two affected countries.

Electricity supplied to rural towns would replace/reduce the consumption of woody biomass and petroleum products used for cooking, lighting, and motive power. It would support development in the agricultural sector (irrigation pumps, poultry, animal husbandry, preservation of products); in the commercial sector (shops, bars, and restaurants); to small and medium industries (flour mills, rural water supply installations, tanneries, and coffee processing plants), to the residential sector (lighting, heating, and cooking), to education (kindergarten, elementary schools, junior secondary schools, secondary schools and technical colleges), and to the health sector (pharmacies, clinics, health centers and hospitals). In brief, the Project would assist in the facilitation of economic growth in Project affected areas and create long-term employment opportunities for the poor, including women, thereby increasing income levels and reducing poverty.

Summary of Impacts for Option C

Impact Issue	Without Mitigation	With Mitigation	Mitigation Measure
Polychlorinated biphenyls	---	Neutral	Implementation of PCB management procedures by EEPCO and NEC
Electromagnetic fields	--	Neutral	Establish 40m ROW, preclude settlement within the ROW
Permanent land loss	- (4.48 ha)	Neutral	Compensation in accordance with RAP for Ethiopia and Sudan
Temporary land loss	-- (962 ha)	Neutral	Compensation in accordance with RAP for Ethiopia and Sudan
Relocation of households	-- (307)	Neutral	Compensation in accordance with RAP for Ethiopia and Sudan
Temporary access roads	-	Neutral	Implementation of best engineering practices (EMP)
Construction traffic	-	Neutral	Implementation of best engineering practices (EMP)
Temporary worker camps	-	Neutral	Implementation of best engineering practices (EMP)
Vegetation clearing (ROW, work sites)	--	-	Implementation of best engineering practices (EMP)
Air and dust emissions	-	Neutral	Implementation of best engineering practices (EMP)
Construction noise	-	Neutral	Implementation of best engineering practices (EMP)
Soil erosion during construction/vegetation clearing	--	Neutral	Implementation of best engineering practices (EMP)
Wildlife	--	-	Prohibit taking of wildlife by workers, minimise vegetation clearing (EMP)

Impact Issue	Without Mitigation	With Mitigation	Mitigation Measure
Risk of bird collision with transmission lines	-	-	Monitor to decide any action required
Influx of people (workers – health impacts, HIV/AIDS)	--	Neutral	Health awareness campaign for workers/local people, health checkups for workers (EMP)
Surface water resources (increased sediments, spillage of oils, lubricants etc.)	--	neutral	Implementation of best engineering practices (EMP)
Safety during construction (workers and local people)	--	Neutral	Contractor to prepare and implement OH&S Plan (EMP)
Safety from transmission line	--	Neutral	Signage, safety awareness campaign targeting local communities (schools)
Maintenance activities for ROW and transmission line	-	Neutral	EMP for Operators (EEPCO and NEC)

- minor negative impact -- medium negative impact --- major negative impact

Summary of Mitigation Costs for Option C

Item	Cost (USD)
RAP compensation for temporary and permanent loss of assets	1,220,000
Environmental Monitoring	27,500
Contractor Environmental staff	36,000
EEPCO/NEC environmental monitoring staff	40,000
Environmental training	20,000
Total	**1,343,500**

The above costs do not include costs for implementing best engineering practices. The RAP costs will be updated prior to Project implementation once Compensation Committees are established. Costs and payments will also be subject to a resettlement audit.

Executive Summary in Arabic

Executive Summary in Amharic

1 Introduction

1.1 Project Background

The Nile Basin Initiative (NBI), established formally in 1999, provides for an agreed basin-wide framework to fight poverty and promote socio-economic development in the ten Nile countries (Burundi, Rwanda, Uganda, Tanzania, Kenya, Sudan, Eritrea, the Democratic Republic of Congo (DRC), Ethiopia and Egypt – see Figure 1). The NBI is led by a Council of Ministers in charge of Water Affairs from the member states, (Nile-COM) with the support of a Technical Advisory Committee (Nile-TAC), and a Secretariat (Nile-SEC). A Strategic Action Program including both basin-wide projects (Shared Vision Program) designed to lay the foundation for cooperative action and two sub-basin programs (Subsidiary Action Programs) of investments, is established to promote poverty alleviation, growth and improved environmental management.

The Shared Vision Program (SVP) is a broad based program of collaborative action to exchange experience, create an enabling environment for investment, enhance capacity, and build trust. The SVP comprises seven projects ready for implementation that have been endorsed by the Nile-COM. These projects include: Trans-boundary Environmental Action; Regional Power Trade; Efficient Water Use for Agricultural Production; Water Resources Planning and Management; Confidence-Building and Stakeholder Involvement (Communication); Applied Training; and Socio-Economic Development and Benefit-Sharing.

The Subsidiary Action Programs (SAPs) are parallel, sub-basin investment programs, identified by sub-groups of the riparian countries. The Eastern Nile Subsidiary Action Program (ENSAP) currently includes the countries of Egypt, Ethiopia, and Sudan. The goal of the Eastern Nile cooperation is to develop the water resources of the Eastern Nile Basin in a sustainable and equitable way to ensure prosperity, security, and peace for all its peoples. Local and national programs will address what needs to be done at local and national levels, while sub-basin cooperation will address development opportunities with trans-boundary implications. Guided by a common understanding of basic principles, the program will initially focus on water and water-related resources in identified areas of cooperation, including: irrigation and drainage development, power development and trade; watershed management, sustainable management of lakes and linked wetland systems, river regulation, flood and drought management, pollution control and water quality management, water use efficiency improvement, and integrated water resources management. In the longer term, it is envisioned that water resources development and management will serve as a catalyst for greater regional integration, with benefits far exceeding those derived from the river itself.

The first ENSAP Program is the Integrated Development of the Eastern Nile (IDEN). The program has been prepared in conformity with the objectives and guiding principles of ENSAP. This program initiates a regional, integrated, multi-purpose program through a first set of investments which confer tangible, win-win gains and demonstrates joint action between the Eastern Nile countries. The IDEN project cycle comprises identification, preparation, design, appraisal, and negotiation prior to project effectiveness, and implementation.

The initial set of proposed projects within the IDEN framework is listed below. The Ethiopia-Sudan Power System Interconnection ESIA Consultancy relates to the first of the IDEN projects.

- **Ethiopia-Sudan Transmission Interconnection Project**
- Watershed Management Project
- Eastern Nile Power Trade Investment Program
- Eastern Nile Planning Model Project
- Baro-Akobo Multi-purpose Water Resources Development Project
- Flood Preparedness and Early Warning Project
- Irrigation and Drainage Project

1.2 Previous Studies

The 1982 Master Plan Study of power development for the Ethiopian Electric Light and Power Authority - EELPA (now EEPCO) first identified the possibility of a power interconnection between Ethiopia and Sudan. A feasibility study entitled "Regional Interconnection of Power Systems between Ethiopia and Sudan" financed by the Finnish International Development Agency (FINNIDA) was completed in February 1988. Although the study found the project to be technically and economically viable no further progress was made to implement the project until in 1994 EELPA and the National Electricity Corporation of Sudan (NEC) agreed to update the feasibility study with a view to proceeding to completing engineering design and preparation of tender documents.

Consultant IVO International Ltd was engaged to undertake the feasibility update and completed its report (Ethiopia-Sudan power Systems Interconnection Study Project: Phase I, Feasibility Study Update) in 1995. Unlike the initial investigation, this study update included an assessment of the socio-economic and environmental aspects of the project. A summary of the findings is presented in Section 6 of this Report.

The 1995 investigation recommended a 428km, 230kV single circuit transmission line with self supported lattice steel towers, upgrading/replacement of existing substations, a fibre optics telecommunications system and supervisory control and data acquisition (Option B1). A further option of a 400/500 kV line was to be considered during final design. The investigation considered three alternative route options in detail.

- Option A: Ghedo-Nekemte-Ghimbi-Kurmuk-Roseires (614 km)
- Option B1: Debre Markos-Injibara-Roseires (428 km) – the preferred route
- Option B2: Bahir Dar-Injibara-Roseires (405 km)

Option B1, with the lowest total cost and acceptable technical performance was recommended to be selected as the least-cost tie-line solution. An additional option, C, starting in Bahir Dar and continuing northwest, either passing Lake Tana on the eastern (Route C1) or western side (Route C2) and continuing to the border town of Metema and then to the Sennar substation via El Gedaref in Sudan was only briefly considered because of its greater length and difficult terrain for line construction.

1.3 Present Study

Further progress with implementation of the project again stalled until it was taken on board by ENTRO and received donor financial support through the World Bank. The Ethiopian and Sudanese Governments agreed to implement the project and carried out line surveys for the Debre Markos to Roseires route which was the recommended route in the 1995 study. Following the line survey, the Ethiopian and Sudanese Governments appointed (through tender) consultants Hifab Oy and SOGREAH Consultants to prepare a feasibility study update which was commenced in January 2005. A draft Report was completed in May 2005 (Ethiopia-Sudan Power Systems Interconnection Project Feasibility Study Update, Draft Report, May 2005). The report provides the most recent description of the proposed project and preferred option and forms the basis of this ESIA Consultancy.

It was originally planned that the Feasibility Update Study and the ESIA/RAP studies would run in parallel with the latter providing input into the Feasibility Update Study. However, because of the delay in undertaking the ESIA/RAP, the Feasibility Study Update was finalised before the ESIA/RAP study.

1.4 Scope and Objectives of ESIA

The World Bank has indicated that it considers the Project to be a category "B" project and as such an Environmental and Social Impact Assessment (ESIA) including an Environmental Management Plan (EMP) and a separate Resettlement Action Plan (RAP) are required. The World Bank has also

requested that separate RAP Reports be prepared for Sudan and Ethiopia to assist with disclosure and to meet Bank funding requirements.

The objectives of the ESIA are to:

1. Identify potential negative and positive environmental impacts of the different alternatives considered.
2. Provide technical information and recommendations to help select and design the best alternative, and;
3. Prepare an environmental management plan (EMP) which includes: a mitigation program, monitoring plan, program of technical assistance; and describes institutional arrangements for the preferred route.

The ESIA has been prepared in accordance with the requirements of the governments of Ethiopia and the Sudan and World Bank policies and procedures (refer to Section 2 on Policy, Legal and Administrative Framework for details).

1.5 Methodology and ESIA Resourcing

1.5.1 Overview

The following methodologies for collecting baseline information for the Project have been formulated on the basis of:

- Relevant documents, including World Bank directives, guidelines and other documents; relevant federal, regional and local legislation, policy papers and guidelines of the Ethiopian and Sudanese land administration, resettlement, cultural and environment sectors;
- Available EEPCO/NEC survey plans (complete with exact transmission line bend points, tower benchmarks, and substations, etc.) and related reports and feasibility studies;
- Practical considerations including timeframe for ESIA, and the accessibility of routes by road (given constraints imposed by the rainy season).

Wherever possible, the Consultant made use of 1:250,000 and 1:50,000 vegetation cover, forestry, topographical and geological maps, soil maps, aerial photographs, and transmission line alignment surveys. The ESIA report also makes use of the socio-economic information collected for the RAP investigation. The locations of the three alternative routes are shown in Figure 2.

1.5.2 Option C

Source of Information

- preliminary site visit and consultations with local officials and affected people
- detailed survey plans for the proposed 132kV single circuit line from Gonder to Shehedi now under construction by EEPCO and survey plans for the sections from Bahir Dar to Gonder and Shehedi to Metema in Ethiopia and from Metema to Gallabat in Sudan
- interviews with government authorities, relevant institutions and NGOs
- RAP investigations
- previous environmental studies in the area

Collection of baseline information relied on both primary and secondary sources, and included an environmental factors survey for discussion with selected samples of local residents and project affected persons (PAPs) who have knowledge of the local ecosystem and its exploitation by traditional methods.

Survey Methodology

A more in depth investigation of the bio-physical environment was undertaken for this route since it was the preferred route under theFeasibility Study Update in 2005. The services of a local ecologist and plant taxonomist were used to carry out the following tasks:

- Description of vegetation types
- Description of species composition and biodiversity
- Listing of any endangered, rare, or vulnerable species
- Estimation of the ecological significance of vegetation types at the regional, national and global level (if significant)
- Assessment of the sensitivity of the ecosystem to the proposed Project intervention in order to identify variables which are likely to experience change
- Interview traditional users of the local natural environment who have first hand information

Socio-economic information for this route was obtained from the RAP study.

Data Analysis

The data collected was validated by experts in the ESIA team. The main output being to:

- Identify environmentally sensitive areas and to assess the area's sensitivity to negative affects from construction and operation of the transmission line and associated structures.
- Assess impacts and changes that may be induced by the transmission line, and identify mitigation measures to avoid or lessen the negative impacts.

1.5.3 Option B (B1/B2)

Source of Information

Collection of baseline information relied mainly on secondary sources with some field investigation, although it included an environmental factors survey for discussion with selected local residents and project affected persons (PAPs) who have knowledge of the local ecosystem and its exploitation by traditional methods. Information sources will include:

- interviews with representatives from institutions relevant to the Project
- site visit and consultations with local officials and affected people
- interviews with government organisations and NGOs
- detailed survey plans for Route Option B1 (Debre Markos to Roseires via Chagni)
- previous environmental studies in the area
- RAP investigations

Survey Methodology

Survey plans are available for the B1 route option only although the section from Chagni to Roseires is common with route B2. The methodological framework for the first section of route B2 from Bahir Dar to Chagni was based on approximate transmission line route information that has been charted onto 1:50 000 topographical maps. Since Option B1/B2 was not the recommended option under the Feasibility Update, the investigation was at a level between a rapid and a detailed appraisal of bio-physical resources to enable comparison with the other route Options being investigated. A local ecologist was used to undertake an appraisal which:

- Characterised the biological resources within the zones of influence of the transmission line route and associated structures.

- Identified environmentally sensitive areas and assess the area's sensitivity to negative affects from construction and operation of the transmission line and associated structures.
- Assessed impacts and changes that may be induced by the transmission line, and identified mitigation measures to avoid or lessen the negative impacts.

1.5.4 Option A

Source of Information

Baseline data relied mainly on secondary sources with some field investigation, although it included an environmental factors survey for discussion with selected local residents and project affected persons (PAPs) who have knowledge of the local ecosystem and its exploitation by traditional methods. Information sources included:

- site visit and consultations with local officials and affected people
- interviews with government organisations, relevant institutions and NGOs
- previous environmental studies in the area
- RAP investigations

Survey Methodology

No precise survey plans are available for this Option and the methodological framework is based on approximate transmission line route information (following the alignment of the Gedo-Asosa 132kV line currently under construction) that has been charted onto 1:50 000 topographical maps. The investigation was therefore at a level of a rapid appraisal of bio-physical resources to enable comparison with the other route Options being investigated. A local ecologist was used to undertake the rapid appraisal which:

- Characterised the biological resources within the zones of influence of the transmission line route and associated structures.
- Identified environmentally sensitive areas and assessed the area's sensitivity to negative affects from construction and operation of the transmission line and associated structures.
- Assessed impacts and changes that may be induced by the transmission line, and identified mitigation measures to avoid or lessen the negative impacts.

1.5.5 ESIA Resourcing

The Consultant's initial input for the preparation of the ESIA and RAP reports was from August to December 2005 during which time the Consultant mobilised teams in Sudan (Khartoum) and Ethiopia (Addis Ababa). The teams included specialists in environmental impact assessment, resettlement, socio-economics, public consultation, environmental legal/policy affairs, archaeology, ecology, health and safety, mapping, telecommunications and transmission engineering. Team members are listed in Appendix 1 of this Report.

This initial period of input was extended to include provision for assessing the environmental impacts of the Bahir Dar to Gonder (Azezo) section of Option C and to complete a full RAP for the three route sections of Option C which had not been surveyed when the Consultant initially mobilised. The sections from Bahir Dar to Gonder and Shehedi to Metema in Ethiopia, and Metema to Gallabat in Sudan were surveyed by EEPCO and NEC respectively in early 2006 after which the Consultant was re-mobilised to complete RAP reports for Ethiopia and Sudan between May and August.

2 Policy, Legal and Administrative Framework

2.1 Ethiopia

2.1.1 The Federal Constitution

The Constitution of the Federal Democratic Republic of Ethiopia, which entered into force on August 21st 1995, forms the fundamental basis for enactment of specific legislative instruments governing environmental matters at the national level. Articles 43, 44 and 92 of the Constitution specifically deal with the right to development, environmental rights and environmental objectives respectively. Thus:

In a section that deals with the right to development:

- Article 43 (1) gives broad right to the peoples of Ethiopia to improved living standards and to sustainable development.
- Article 43 (2) acknowledges the rights of the people to be consulted with respect to policies and projects affecting their community.
- Article 43 (3) requires all international agreements and relations by the State to protect and ensure Ethiopia's right to sustainable development.

In a section that deals with environmental rights Article 44guarantees the right to a clean and healthy environment.

In a section that deals with environmental objectives, Article 92 sets out the Federal policy principles and significant environmental objectives. More specifically Article 92:

- affirms the commitment of the Government to endeavour to ensure that all Ethiopians live in a clean and healthy environment.
- warns that the design and implementation of development programs and projects not to damage or destroy the environment.
- guarantees the right of the people to full consultation and the expression of views in the planning and implementation of environmental policies on projects that affect them directly.
- imposes the duty on Government and citizens to protect the environment.

In the context of land ownership and holding right:

- Article 40 (3) vests the right to ownership of rural and urban land, as well as of all natural resources, in the government and in the peoples of Ethiopia.
- recognises land as a common property of the Nations, Nationalities of and peoples of Ethiopia and prohibits sale or any other exchange of land.
- Article 40 (4) guarantees the right of farmers to obtain land without payment and the protection against eviction from their possession.
- Article 40 (5) guarantees the right of pastoralists to free land for grazing and cultivation as well as the right not to be displaced from their own lands.

In recognition of the value of human input on land Article 40 (7) states that "Every Ethiopian shall have the full right to the immovable property he builds and to the permanent improvements he brings about on the land by his labour or capital. This right shall include the right to alienate, to bequeath, and, where the right to use expires, to remove his property, transfers his title, or claim compensation for it."

In recognition of the right to acquire property for the purpose of overriding national interest Article 40 (7) empowers the Government to expropriate private property for public purposes subject to payment in advance of compensation commensurate to the value of the property."

In a section that deals with economic, social and cultural rights Article 41 (9) sets out the State responsibilities to protect and preserve historical and cultural legacies.

2.1.2 Environmental Policy of Ethiopia

The Environmental Policy of the Federal Democratic Republic of Ethiopia was approved by the Council of Ministers in April 1997. Its overall policy goal may be summarised in terms of the improvement and enhancement of the health and quality of life of all Ethiopians, and the promotion of sustainable social and economic development through the adoption of sound environmental management principles. The policy is integrated with the overall long term strategy of the country - agricultural led industrialization and other key national policies. It sets out its specific objectives and key guiding principles, contains sectoral and cross-sectoral policies and provisions necessary for the appropriate implementation of the Policy itself.

With respect to environmental impact assessment (EIA) the Policy sets out specific policies, key elements of which may be summarized hereunder:

- The need to address social, socio-economic, political and cultural impacts, in addition to physical and biological impacts, and to integrate public consultation within the EIA procedures.
- Incorporation of impact containment measures into the design process of public and private sector development projects and inclusion into EIA of mitigation measures and accident contingency plans.
- Development of detailed technical sectoral guidelines for EIA and environmental auditing.
- Establishment of an interlinked legal and institutional framework for the EIA process to ensure that development projects are subjected to environmental impact assessment, audit and approval in a coordinated manner.
- Development of EIA and environmental auditing capacity within the Environmental Protection Authority, sectoral ministries and agencies as well as regions.

The Policy has been developed as a national instrument enhancing the objectives of the Constitution and setting out clear cut directions with respect to environmental concerns particularly in terms of regulatory measures adopted as well as in the process of design, implementation and operation of development projects. Its recognition of the significance of addressing cross-sectoral environmental issues in the context of a national approach to environmental assessment and management integrates the efforts of a wide range of institutions across the country. It provides a sound and rational basis for addressing the country's environmental problems in a coordinated manner.

2.1.3 Sectoral Policies

As measures to effectively deal with environmental problems several sectoral policies have been issued. These include:

- National Population Policy issued in April 1993
- National Policy on Women issued in March 1993
- National Agricultural Resource Policy and Strategy issued in 1993
- Energy Policy issued in 1994
- Water Resource Management Policy
- Policy on Biodiversity Conservation and Research issued on April 1998
- Rural Development Policy and Strategy issued in 2002
- Sustainable Development and Poverty Reduction program issued in 2002

The broad guiding principles under the Federal Constitution and the more instructive directions set out under the Environmental Policy of Ethiopia have been further expanded and refined by three

environmental framework legislations designed to enable implementation of the Federal policies on environment. These legislations are instrumental to translating the broad objectives of the policies into practice, as they provide for specific rules of substance and procedures having the force of law across the country. The legislations are described below.

2.1.4 Institutional Arrangement for Environmental Protection

Of paramount significance in terms of institutional framework for environmental protection is the Environmental Protection Organs Establishment Proclamation No. 295/2002, which entered into force on October 31st 2002. This Proclamation establishes the institutional arms of the Federal Government to ensure the realisation of the objectives of the Constitution and of the Environmental Policy of Ethiopia with respect to environmentally sustainable management of economic and social development of the country, both at Federal and Regional level.

The Proclamation directs every relevant sectoral agency of the Federal Government to set up an environment unit as part of its organisational structure and also for each Regional State to establish a Regional autonomous environmental agency. Apart from assigning specifically defined responsibilities to the Environmental Protection Authority the Proclamation links the efforts of Regional states with that of the Authority by instructing the Regional states to prepare and submit reports on the respective state of the environment and sustainable development and submit them to the Authority.

The significance attached to the Authority is reflected in its composition which is made up of a Council comprising members drawn from the Prime Ministry, Federal Government, Regional States, Ethiopian Chamber of Commerce, Confederation of Trade Unions and local NGOs involved in environmental protection and the Director General of the Authority. The Council is entrusted with the responsibilities of reviewing environmental policies, strategies, laws, providing advice on the implementation of environmental policies, and evaluating the guidelines and environmental standards prepared by the Authority. This guarantees that the Council has approved all guidelines and environmental standards issued by the Authority.

2.1.5 Environmental Impact Assessment Proclamation

This Proclamation (No 299/2002) aims primarily at making environmental impact assessment (EIA) mandatory for categories of projects specified under a directive issued by the Authority whether such projects belong to public or private bodies. The Authority issued several directives subjecting categories of projects to environmental impact assessment. The Proclamation describes a policy, strategy, program, law or an international agreement as “public instrument” and directs the Authority to issue guidelines distinctively classifying certain categories of public instruments as likely to entail significant environmental impact.

The Proclamation requires, among others:

- Specified categories of projects to be subjected to EIA and receive an authorization from the Authority or the relevant Regional Environmental Agency prior to commencing implementation of the project.
- Licensing agencies to ensure that the requisite authorisation has been duly received prior to issuing an investment permit, a trade or operating license or a work permit to a business organisation.
- The Authority or the relevant Regional environmental agencies may exempt from environmental impact assessment projects with insignificant environmental impact.
- A licensing agency may suspend or cancel a licence that has already been issued where the Authority or the relevant Regional environmental agency suspends or cancels environmental authorization.

Procedures that need to be followed in the process of environmental impact assessment are described in the Proclamation. Thus a project initiator (Proponent):

- Must undertake a timely environmental impact assessment, identifying the likely adverse impacts, incorporate the means of their prevention, and submit the environmental impact study report accompanied by the necessary documents to the Authority or the relevant Regional environmental agency.
- Must ensure that an environmental impact assessment is conducted and an environmental impact study report prepared by an expert who meets the requirements set forth by the directive issued by the Authority.
- Must submit an environmental impact study report to the Authority or the relevant Regional environmental agency for review.

The Proclamation directs the Authority and the relevant Regional environmental agency how to deal with an environmental impact study report they receive. Thus, after evaluating the report by taking into account any public comment and expert opinion the Authority or the relevant Regional environmental agency must do one of the following:

- Approve the project without condition and issue authorisation if it is satisfied that the project may not cause negative impact.
- Approve the project and issue authorisation with condition that must be met in order to reduce adverse impacts to insignificant impacts, or
- Refuse implementation of the project if the negative impact cannot be satisfactorily avoided.

In the event of a project having likely trans-national impact within Ethiopia the Regional environmental agency would not assess an environmental impact study itself, but refer the report to the National Authority. The Proclamation has no provision regulating environmental impact assessment of projects crossing the borders of Ethiopia.

2.1.6 Environmental Pollution Control Proclamation

This Proclamation primarily aims to ensure the right of citizens to a healthy environment and to impose obligations to protect the environment of the Country. In this connection the Proclamation provides a basis from which the relevant environmental standards applicable to Ethiopia can be developed and sanctions violation of these standards as criminally punishable offences.

In order to ensure implementation of environmental standards and related requirements, inspectors of the Authority or of the relevant Regional environmental agency are empowered by the Proclamation to enter, without prior notice or court order, any land or premises at any time, which seems to them appropriate. Such a wide discretionary power of inspectors explains the serious concern and commitment of Ethiopia to the protection of environment from pollution.

2.1.7 Legislation on Expropriation of Land and Compensation

The Federal legislation on Expropriation of Land for Public Purposes & Compensation (Proclamation No. 455/2005) impliedly repealed the outdated provisions of the Ethiopian Civil Code of 1960 regulating land acquisition and compensation for the purpose of public projects. This new legislation established detail procedures setting the time limits within which land could be acquired after a request is received from a proponent, principles for assessment of compensation for properties on the land as well as for displacement compensation. It also empowered the Woreda administration to establish valuation committees to value private properties. In the case of public-owned infrastructures to be removed from the right-of-way the owners of the structures would assess the value of the properties to be removed. Additionally the legislation provided for appeals from valuation decisions but such action would not delay transfer of possession of land to the proponent or contractor appointed by the proponent.

The Proclamation has removed the barriers for planned land acquisition, substantially raised the amount of compensation payable to expropriated owners of properties and displaced people. In addition to financial compensation in an amount sufficient to reinstate the displaced people to the economic position prior to displacement, the relevant Regional administration is required to give

replacement land to any person who has lost land in favour of a public project. Assessments of compensation does not include the value of the land itself since land is a public property not subject to sale in Ethiopia.

To the extent that the infrastructures to be constructed for the Ethiopia-Sudan Power Interconnection Project are only substations and conventional lattice self-supported steel towers, land acquisition is unlikely to pose a substantial problem to the proposed project, because the:

- The nature of the project is such that allows cultivation of farmland and grazing in the right-of-way, the only exceptions being plantation of large trees that would disturb transmission lines and maintaining houses for residential and other social services, as theses are vulnerable to possible electromagnetic radiation from the high voltage transmission line.
- Replacement houses may be relocated in the same plot of land or in the near vicinity to those demolished without causing separation from social ties within the established communities.

The responsibility of a proponent of a proposed project under Ethiopian law does not extend beyond the payment of compensation for properties and displacement. In other words the displaced people need to seek resettlement options in the framework of land administration systems of the relevant rural or urban land administration.

2.1.8 Legislation on Preservation of Cultural Heritage

The Research and Conservation of Cultural Heritage Proclamation No. 209/2000 of Ethiopia defines cultural heritage broadly as "anything tangible or intangible which is the product of creativity and labour of man in the pre-history and history times, that describes and witnesses to the evolution of nature and which has a major value in its scientific, historical, cultural, artistic and handcraft content."

Prior approval of the Authority for Research and Conservation of Cultural Heritage is required to remove from its original site, an immovable cultural heritage (Art. 21/1). Whenever a registered movable cultural heritage is encountered during the execution of the project it is possible to remove such property by notifying the Authority in advance (Art. 21/2).

Any person who destroys or damages cultural heritage intentionally shall be punished with gregarious imprisonment not less than 10 years and not exceeding twenty years (Art. 45/2/).

2.1.9 Environmental Guidelines

As a step forward in developing the environmental policies and legislations the Environmental Protection Authority issued a procedural guideline which defines specific examinations to which a proposed project needs to be subjected in the process of environmental impact assessment. The procedural guideline currently in effect is one that was issued in November 2003 and sets forth the various stages of evaluation that a project proposal needs to pass through. These stages are pre-screening consultation, screening, scoping, environmental impact study, reviewing and decision-making. Pre-screening consultation is not an actual stage in the EA process but a point where the proponent and the relevant environmental organ establish contact and hold consultation on how best to proceed with the EA. The environmental organ may also conduct environmental audit or surveillance of a project to ensure compliance with the environmental quality criteria or other provisions stated in the environmental impact assessment.

The procedural guideline requires a proponent to submit an initial environmental examination report to enable the relevant environmental agency to decide the application of a further level of assessment depending on the outcome of a screening report. At this level of examination the decision may be either of the following: no EA required, preliminary assessment is applied to or full scale EA applies where the project is found to be one that may have significant impacts.

The Ethiopian Environmental Protection Authority has issued other guidelines for environmental and social impact assessment of projects in different sectors. These include:

- Guidelines for Dams and Reservoirs, 2004
- Guidelines on Irrigation, 2004
- Guidelines for Mineral and Petroleum Operation Projects, 2003
- Guidelines on Road and Railway, 2004
- Guidelines on Hydropower Production, Transportation and Distribution

These guidelines provide a comprehensive statement of the type of adverse impact that may occur and set out clearly the aspects, which need to be addressed in an initial environmental examination and in an environmental and social impact assessment. The guidelines are clear and understandable in their application, and more importantly provide a sound basis for examination and assessment of projects in the sectors for which they were designed. The source of references and further reading accompanying each guideline point out the extent of professional research conducted to develop the guidelines and encourages further reading in selected areas covered by the guidelines.

2.1.10 Institutional and Administrative Framework

The institutions responsible to ensure implementation of environmental public instruments at Federal and Regional levels are key role players whilst sectoral institutions engaged in development activities reinforce the efforts of the key institutions as partners to the key institution. The key institutions devote their time fulltime to environmental matters, as they were established for that purposes while sectoral institutions were established for other purposes with limited environmental responsibilities. The later enhance the objectives of environmental institutions by complying with the environmental objectives of the country in the course of preparing and implementing their own projects.

Ethiopian Environmental Authority

The key intuition at Federal level is the Ethiopian Environmental Protection Authority (EPA), which was established on October 31 2002 by Proclamation No. 295/2002. It is the Federal institutional arm entrusted with the widest responsibilities on environmental protection. The Authority reports directly to the Prime Minister and is responsible for:

- Preparation of environmental policies and laws and to ensure that these are implemented.
- Preparation of directives and implementation of systems necessary for the evaluation of the impact of projects on the environment.
- Preparation of environmental protection standards and implementation of directives concerning soil, water and air.
- Preparation of recommendations regarding measures needed to protect the environment.
- Enhancement of environmental awareness programs.
- The conduct of studies on desertification and the coordination of efforts to combat it.
- Implementation of international treaties concerning the environment to which Ethiopia is a signatory.
- Provision of advice and technical support to the regions on the environmental matters.

The Proclamation gives the EPA a mandate to involve itself with all environmental issues and projects that have a Federal, interregional and international scope. Most of the powers of the EPA relate to coordination and monitoring aspects.

Regional Environmental Agencies

Proclamation No. 295/2002 empowers each Regional state to establish its own independent environmental agency with the responsibilities to coordinate and follow-up the Regional effort to ensure public participation in the decision making process, to play an active role in coordinating the formulation, implementation, review and revision of Regional conservation strategies as well as to foster environmental monitoring, and protection and regulation.

Sectoral Environmental Units

Each Federal and Regional organisation of the government that deals with environmental matters is required by Proclamation No. 295/2002 to set up its own unit with the responsibilities to coordinate and follow-up to ensure that its activities are in harmony with national efforts to protect the environment. Several institutions including the Ethiopian Electric Power Corporation (EEPCO) have established their in-house environmental unit.

National and Regional Conservation Strategies

Ethiopia has formulated a National Conservation Strategy which takes a holistic view of the natural, cultural and human resources and seeks to integrate into a coherent framework, plans, policies and investment related to environmental sustainability. Within this framework, region-specific conservation strategies have been formulated and these have been taken into consideration for this ESIA. The Amhara Region has in place its own Regional Conservation Strategy (Amhara National Regional State, 1999).

2.1.11 Adequacy of Environmental Procedures and Guidelines

This Section examines the environmental guidelines and procedures considered above to see whether they are adequate for the environmental assessment of the Ethiopian-Sudan Power System Interconnection Project. This calls for consideration of the relevant guidelines and procedures in the light of the nature, scope and physical location of the proposed Project.

The term "guideline" was referred to in Section 4.9 of the Ethiopian Environmental Policy under the heading "Environmental Impact Assessment". It provides for the development of detailed technical sectoral guidelines for EIA and environmental auditing. The Ethiopian Environmental Protection Authority has issued numerous guidelines and of particular relevance to this Project are:

- Environmental Impact Assessment Procedural Guidelines Series 1, November 2003; and
- Integrated Environmental and Social Impact Assessment Guidelines, Hydropower Production, Transportation and Distribution, 2004.

The Procedural Guidelines contain the legal and policy elements, core values, guiding principles, basic requirements and schedule of activities. Energy industry is one of the eleven activities covered by the Energy Guidelines. The Guidelines provide for:

- Production and distribution of electricity, gas, steam and hot water
- Storage of natural gas
- Construction of offshore pipelines in excess of 50 km in length
- **High voltage transmission lines**
- Construction of combined cycle power station
- Thermal power development (i.e. coal, nuclear)
- Hydroelectric power
- Bio-mass power development
- Wind-mills power development
- Solar (i.e. impact due to pollution during manufacture of solar devices, acid battery spillage and improper disposal of batteries)
- Nuclear energy

The Feasibility Study Report (Para.3.9, Hifab Oy *et. al*. 2005) indicates that the two countries would assign their respective responsibilities for the construction, operation and interconnection of the power system to individual institutions- Ethiopia to EEPCO and Sudan to NEC. The said Report further states that:

- The responsibilities for construction, ownership, operation and maintenance of the facilities fall to each party in its territory.
- The construction agreement to be separately entered into between works contractors and EEPCO and NEC would specify the objectives of the interconnection, ownership right and financial obligation of each.
- Individual ownership of line by each party is defined as up to the country border.

The Environmental Impact Assessment Proclamation No. 299/2002 defines any organ of the government, if in the public sector or any person if in a private sector that initiate a project as a "Proponent. Under this definition EEPCO would be the Proponent of the project in order to discharge the responsibilities set out by Proclamation No. 299/2002 for conducting EA for the project within the territory of Ethiopia.

Ethiopian environmental legislation does not provide for EA assessment of a bilateral project crossing the international border of Ethiopia. This, however, does not preclude treatment of the Project in question as an "Ethiopian Project" for the purposes of applying Ethiopian environmental policy, legislations and guidelines for a section of the Project that physically falls within Ethiopian territory unless otherwise provided by a bilateral treaty between the two countries.

2.2 Sudan

2.2.1 The Interim National Constitution

Sudan is a federal country divided into 26 states with special consideration given to Southern Sudan according to the Interim Constitution of 2005. The Interim National Constitution of the Republic of the Sudan (dated 10 July 2005) provides for the protection of the environment and social justice, wherein:

Section 11

- Guarantees the right of the Sudanese people to a clean and diverse environment while imposing a duty on the citizens to preserve and promote the country's biodiversity.
- Precludes the State from pursuing any policy, or taking or permitting any action, which may adversely affect the existence of any specious animals or vegetative life, their natural or adopted habitat.
- Guarantees that the State shall promote, through legislation, sustainable utilisation of natural resources and best practices with respect to their management.

Section 12 requires the State:

- to develop policies and strategies to ensure social justice through insuring means of livelihood and opportunities of employment.
- to encourage mutual assistance, self–help, cooperation and charity.

Ownership of private property is guaranteed under Section 43 subject to expropriation by law in the public interest and in consideration for prompt and fair compensation.

Section 24 describes the Sudan as a decentralised State with four levels of government.

1. National level of government with the power to protect national sovereignty, and territorial integrity of the entire Sudan and to promote the welfare of its people.
2. Southern Sudan level of government with the power to exercise authority in respect of the people and States in Southern Sudan.
3. State level of government with the power to exercise authority at the State level throughout the Sudan, and render public services through the level closest to the people.
4. Local level of government, which shall be throughout the Sudan.

Section 186 of the Interim Constitution:

- Endorses concurrent competences of the appropriate levels of government on regulating land tenure, usage and exercise of rights;
- Empowers the appropriate or designated levels of government to exercise their respective rights in government land;
- Instructs all levels of government to progressively develop and amend the relevant laws to incorporate customary laws and practices, local heritage and international trends and practices.

Section 187 affirms the Commitment of the Government to Establish a National Land Commission with functions including arbitrating disputes arising in relation to land, and advising different levels of government on how to coordinate policies on national projects affecting land and land rights. The Commission shall be independent and representative of all levels of government and accountable to the Presidency. Southern Sudan would also have its own Land Commission with functions specified in the Comprehensive Peace Agreement (Section 188).

The Interim Constitution has five Schedules (Schedules A-F), which more specifically state the powers of the various levels of government in respect of, among others, environment, land acquisition and conservation of cultural heritage. Such powers include:

1. Schedule A exclusive legislative and executive powers at the National level dealing with:
   - Natural Lands and National natural resources (item no. 15),
   - Meteorology (item no. 19),
   - Signing of International Treaties on behalf of the Republic of the Sudan (item no. 2 5),
   - National Public Utilities (item no. 30),
   - National Museums and National heritage Sites (item no. 31),
   - National Economic Policy and Planning (item no. 32), and
   - Nile Water Commission, the management of the Nile Waters and transboundary waters and disputes arising from the management of interstate waters between Northern States and any dispute between Northern and Southern States (item no. 31),
2. Schedule B exclusive legislative and executive powers of the Government of Southern Sudan dealing with:
   - Wildlife Services (Item no. 2)
   - Public Utilities of the Government of Southern Sudan (Item no. 14)
   - Reconstruction and Development of the Southern Sudan (Item no. 16)
   - Natural Resources and forestry in so far as these cannot be dealt with effectively by a single state and the legislation or intervention of the Government of Southern Sudan is required (Item no. 19 (2)), and
   - Town and Rural Planning in so far as these cannot be dealt with effectively by a single state and the legislation or intervention of the Government of Southern Sudan is required (Item no. 19).
3. Schedule C exclusive legislative and executive powers of the State include the following:
   - State Land and State Natural Resources (Item no. 8)
   - Cultural matters within the State (Item no. 9)
   - Enforcement of State laws (Item no. 19)

- The development, conservation and management of State natural resources and State forestry resources (Item no. 21)
- Laws relating to agriculture within the State (Item no. 23)
- Pollution control (Item no. 27)
- Quarrying regulations (Item no. 31)
- Town and rural planning (Item no. 32)
- State cultural and heritage sites and other historical sites (Item no. 33)
- Traditional and customary law (Item no. 34)
- State irrigation and embankments (Item no. 36)
- State archives, antiquities and monuments (Item no. 38), and
- State public utilities (Item no. 40)

4. Schedule D legislative and executive competencies (concurrent powers) of the National Government, the Government of Southern Sudan and State governments dealing with:
    - Economic and social development in Southern Sudan (Item no. 1)
    - Health policy (Item no. 4)
    - Urban development, planning and housing (Item no. 5)
    - Delivery of public services (Item no. 7)
    - Electricity generation and water and waste management (Item no. 15)
    - Environmental management, protection and conservation (Item no. 17)
    - Relief, repatriation, resettlement, rehabilitation and reconstruction (Item no. 18)
    - Financial and economic policies and planning (Item no. 20)
    - Consumer safety and protection (Item no. 24)
    - Water resources other than interstate waters (Item no. 27), and
    - Regulation of land tenure, usage and exercise of rights in land (Item no. 32)

Schedule E provides for residual powers exercised by the relevant level of government depending on the nature to which they relate. Schedule F deals with the resolution of disputes in relation to concurrent powers of the four levels of government.

2.2.2 Legislative Framework

The Environment (Protection) Act, 2001

Sudan is one of the first African countries that passed sectoral laws for the protection of the environment. The Environment (Protection) Act, 2001 that was enacted in accordance with the former Constitution of the Republic of the Sudan is the principal legislative framework providing for uniform rules of substance and procedures on protection of the environment and use of natural resources. The Act also provides definitions and clarifications regarding natural resources management, pollutants and sources of pollution, and endorses the "Polluter Pays" principle. Section 4 of the Act sets forth the environmental objectives of the Sudan as follows:

a) Protection and preservation of the natural environment, or the basic elements and the social and cultural systems thereof, in achievement of safety and sustainable development for the benefit of future generations;

b) promoting the environment and sustainable use of the natural resources, for the purpose of sustainable development;

c) linking the issues of environment and development; ascertaining the responsibility of the competent authority for protection of the environment and, and promoting the need for achieving such protection;

d) Establishing the role of the competent authority and the organs belonging thereto, and enforcing their roles.

Section 5 provides for the establishment of the Environment and Natural Resources Supreme Council based in Khartoum State and operating under the supervision of the President of the Republic with functions and powers principally to:

1. Prepare the general policy in matters pertaining to natural resources and protection of the environment in general (Section7);
2. Coordinate the functions and efforts of the states' councils to determine and evaluate the country's natural resources;
3. Establish a long term Federal program for the most ideal and balanced use of the natural resources, maintenance and conservation of the natural resources;
4. Periodically revise the relevant environmental legislation to ascertain comparability and fairness with international standards, for the development of the environment and natural resources;
5. Establish a Federal plan for the promotion of environmental awareness and sustainable use and maintenance of natural resources, and strive to include the same in the educational curricula, in cooperation with the competent bodies.

Section 17 designates certain institutions as "Competent Authorities" and entrusts to them the responsibilities to strive to achieve the broad environmental objectives specified in Section 4 of the Act. These institutions are:

1. The Supreme Council
2. The Federal Ministries, organs and institutions concerned with health, and protection of the environment, in all the health, agricultural, industrial, housing, economic, cultural and social fields
3. State's councils and Ministries, and
4. National and foreign societies and institutions interested in promotion and protection of the environment permitted to work in the Sudan.

Section 18 sets forth the general policies and directives on environment and natural resources. It requires a proponent of projects to conduct an EIA study, before embarking on any development activity in order to identify the positive and negative environmental impacts of the project, together with suggestions to mitigate the negative impacts. More specifically, every proponent of a project that is likely to affect the environment and natural resources is required (irrespective of duly issued permit by the relevant authority) to present an environmental feasibility study, which shows:

- the expected impact of the proposed project upon the environment;
- how adverse impacts of the project can be mitigated through appropriate safeguards;
- project alternatives;
- sufficient explanation that the short term exploitation of the natural resources and the environment does not affect the proffering of such resources in the long term;
- where the project is connected to exploitation of the non-renewable natural resources, the said feasibility study shall include the continued exploitation of such resources;
- mitigation measures as may be adopted for containing and restricting the negative effect of the project.

Section19 directs the Competent Authorities in the State to discharge a wide range of functions including to:

- issue and approve environmental standards to protect the environment;
- conserve and protect against pollution and deterioration of water sources;
- conserve and protect against pollution and deterioration of air food, soil and vegetation cover;
- conserve animals and other living organisms, and protect them from extinction;
- conserve archaeological tourist sites and protect them against deterioration and damage.

Section 20 imposes a duty on every person to report to the competent authority any danger as may threaten the environment and to tender the necessary assistance to protect the environment, and to receive a refund any expenses incurred in so doing. A project may be suspended or a license may be revoked for contravention of the Act (Section 22). Article 28 refers to the application of International Environment Agreements ratified by Sudan (refer to Section 2.6).

Thus protection of the environment and natural resources in the Sudan is a nation – wide responsibility assigned not only to the government but to every individual as well.

In order to implement the provisions of the Act, a Higher Council for Environment and Natural Resources (HCENR) was established in 1991 and later on a Ministry for Environment and Physical Development (MEPD) was established in 1995. The 2001 Act was an amendment to previous acts that established the HCENR and MEPD.

Relevant articles of the Interim National Constitution of 2005 and the Environment Conservation Act of importance to this Project are the right to expropriate land and compensate the owners as well as issues related to safety and protection of the inhabitants, penalties for environmental damage, pollution protection and adherence to International Environmental Agreements ratified by Sudan. Specific details and procedure on land are found in sectoral laws including:

- *Land Registration and Settlement Act 1925* provides rules to determine rights on land and other rights attached to it and ensure land registration.
- *Land Acquisition Act 1930* gives the government the power to appropriate lands for development purposes. It contains detailed procedures to be followed in acquisition of land and rules governing payment of compensation for land required for public purposes. The procedures for land acquisition in any locality are initiated with notification by the People's Executive Council in a Gazette stating that it appeared to the President of the Republic to authorise the acquisition of land for public purposes (Section 4). It is only afte such notification that it shall be lawful to enter into, bore, set out boundaries, mark or survey land.

  An appropriation officer appointed by the People's Executive Council would notify the occupant whose land is to be appropriated for public purposes, call upon persons claiming compensation to appear before him at a place and time (not earlier than 14 days) and to state the particulars of their claims for compensation (Section 10). He must attempt to agree on the amount of compensation for that land (Section 10). The Act provides for further steps to be taken with regard to assessment of compensation if agreement is not reached.
- *Unregistered Land Act 1970* deems any unregistered land, before the enactment of this law, as being registered in the name of the government.
- *The Civil Transactions Act 1984* regulates the different matters related to civil transactions with respect to titles on land, means of land acquisition, easement rights and conditions to be observed by land users.
- *Urban Planning and Land Disposal Act 1994* regulates designation of lands for different purposes and urban planning. With respect to land expropriation for public purposes, Section 13 of the Act recognises the application of its predecessor – Land Acquisition Act 1930.

- *Central Forests Act, 1932* empowers the Minister of Agriculture, Food and Natural Resources to declare a central forest reserve an area of land, which is registered under the Land and Settlement and Registration Act, 1925 as Government land (Section 5). Unless a special license or a permit has been first obtained from the Director of Forest, any act, including entry upon or remaining in such forests are an offence (Sections 9 & 10 of Central Forest Act, 1932). Central forest reserves are located in the provinces of Blue Nile, Khartoum and Geizira (Schedule to the Act).
- *Provincial Forest Act, 1932* protects an area in Geizera province as provincial forest reserve from being interfered with on the same principle as applied to the Central Forest Reserve.
- *The Environmental Health Act, 1975* contains detailed provisions for the protection of water and air from pollution and assigns defined administrative responsibilities to District Councils with respect to preservation of environmental health in general.

In carrying out EIA, the legal requirements are not confined to the above mentioned Acts. There are other important sectoral laws that must be considered and used as a yard stick or standard to identify the negative environmental effects. The *Electricity Act of 2001* controls the electricity market. It provides regulations regarding the protection of network and standards regarding environmental protection. Article (9) of the said Act requires that any developer (investor) must comply with existing laws regarding roads, water courses, communication network, environmental issues and archaeological sites. Article (13) explains the environmental standards that must be taken into consideration when establishing power plants. Article (17) requires compensation to any damage that the project may cause to humans, animals and property.

Other laws of relevance to this project include; the *Investment Act of 1999* which requires an EIA study as a condition for granting a licence to implement a project, the *Industrial Safety Act 1976* which tries to protect the work environment and safety of workers and the *Location of Industries Act of 1977* which prohibits the location of industries in residential areas.

2.2.3 Relevant Policies and Institutions

Two key strategies deal with sustainable development in the Sudan, namely:

1. Environment Strategy (part of the comprehensive strategy) 1992 – 2002.
2. Quarter Century Strategy 2002 – 20027.

The Institutions of most relevance to this Project are:

- The Ministry of Environment and Physical Development (MEPD)
- The Ministry of Electricity
- The Ministry of Urban Planning and Housing.

The reviewed Acts and laws provide standards to be considered in assessing the environmental impacts of the Project. It is important to note here that State organs and local laws deal with issues at State or local levels, while the Federal Acts are more concerned with general directives and set limits and standards to certain environmental concerns without detailing problems of a local nature.

Based on the provisions of these legal requirements and sectoral laws as well as policies of NEC, the impacts of the proposed Project will be assessed and detailed in the various sections of this report.

Both in Ethiopia and the Sudan concerns for environmental protection are reflected in major legal instruments (Constitutions and Proclamations/Acts). Such instruments cover detailed provisions guiding the environmental and social impact assessment of projects. Both countries have institutional arms in place that would ensure implementation of the policies and legislations in their respective countries. Thus the legal and institutional framework in the two countries is in place to adequately assess the Project and ensure that adequate measures are undertaken to minimise the adverse impacts and to ensure that project affected persons are not adversely disadvantaged.

2.3 Institutional Capacity within Ethiopian and Sudanese Power Authorities

2.3.1 EEPCO

EEPCO has established its own in-house environmental unit in the last two years and is in the process of developing the Unit's capabilities through assistance from the World Bank. The Environmental Monitoring Unit (EMU) consists of less than 10 professional staff with expertise in the fields of forestry, environmental management and sociology at present. This is likely to expand following further development of the Unit over the next few years and as the Unit becomes more integrated into EEPCO's operations.

Demands on EMU from within EEPCO are also likely to increase as staff within the organisation become more aware of its existence and the support it can provide both during project implementation and operation and, equally importantly, during project development and planning.

EMU staff are currently gaining practical environmental monitoring and management experience through direct involvement in a number of projects within EEPCO, including projects under the Energy Access and Rural Electrification Programs, the Ethiopia-Djibouti Power Transmission Project and the GilGel Gibbe Hydroelectric Project which involves resettlement and compensation issues. EEPCO is also currently overseeing the resettlement/compensation component of the Gimbi-Mendi-Asosa Power Transmission Project and the procedure for payment and amounts paid have been documented and made available for the Consultant to view as an indication of EEPCO's capability to implement compensation and resettlement matters.

EEPCO has developed its own sectoral environmental guideline (Environmental Guideline for the Power Sector: Operational Manual, prepared by Corporate Planning Environmental Monitoring Unit – EMU, December 2004) which is based on the environmental guidelines of the National EPA (EPA 2000). The guideline could be more effective with supporting policies endorsed by EEPCO management and a greater awareness of environmental issues by project managers and other staff within the organisation.

2.3.2 NEC

The Ministry of Electricity has established an office (Electricity Regulatory Authority) with functions to advise on all issues related to the power industry and to provide technical advice including environmental issues. Unlike EEPCO, NEC has not established a separate environment unit and there is little environmental awareness training available for NEC staff.

While NEC does not have sectoral environmental guidelines, it adheres to the Environmental Act (2001) and regulations particularly with respect to EIA studies to be undertaken before implementation of any new project. The EIA study must be approved by HCENR demonstrating that at power plant levels, there is concern for environmental issues as well as implementation of monitoring programs and emergency plans.

NEC needs to build its capacity in monitoring and implementation of environmental management plans to be able to effectively implement the environmental monitoring and management requirements of the Project. NEC would benefit greatly with assistance to establish an in–house environmental unit and in the development of sectoral environmental guidelines together with a program for raising environmental awareness within the organisation.

2.4 Private Sector Capacity

Construction Contractors for the Project will be appointed through international competitive bidding and contract documentation will include environmental monitoring and management requirements from the ESIA and RAP Reports. Such requirements are standard practice and most international contractors are aware of the need to carry them out. However, the level of adherence is often dependent on the environmental monitoring and management expertise of the Supervising Consultant and the relevant sectoral agency, which in this case is EEPCO and NEC.

It is important therefore that Contractors are provided with detailed environmental monitoring and management plans and that Contractor staff are given on-site environmental training by the supervision consultant and EEPCO/NEC prior to the commencement of construction activities.

2.5 World Bank

The World Bank provides guidance on EIA requirements through the Environmental Assessment Sourcebook (World Bank 1994) which includes sectoral guidelines. The World Bank EIA process is implemented through a set of Operational Policies/Directives whose primary objective is to ensure that Bank operations do not cause adverse impacts and that they "do no harm". These safeguard policies are grouped into Environment, Rural Development, Social Development and International Law.

The following safeguard policies have been considered in this ESIA.

2.5.1 Environment

OP/BP 4.01 Environmental Assessment (January 1999)

Ensures that appropriate levels of environmental and social assessment are carried out as part of project design. It also deals with the public consultation process, and ensures that the views of project-affected persons/groups and local NGOs are taken into account. It outlines the contents of environmental assessment reports and environmental management plans for Category A projects.

OP/BP 4.04 Natural Habitats(June 2001)

Supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable develoment. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

2.5.2 Rural Development

OP 4.09 Pest Management (December 1998)

Promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides, and defers to the World Health Organisation's "Recommended Classification of Pesticides by Hazard and Guidelines to Classification" criteria for pesticide selection and use.

OP 4.36 Forests (November 2002)

Aims to reduce deforestation and enhance, through sustainable economic development, the environmental and social contribution of forests. The Bank dos not support projects which involve significant conversion or degradation of critical forest areas or related critical natural habitats.

2.5.3 Social Development

OP/BP 4.11 Physical Cultural Resources (July 2006)

Cultural property is defined to include both remains left by previous human inhabitants (e.g. middens, shrines) and unique natural environmental features such as canyons and waterfalls. The Bank does not support projects that will significantly damage non-replicable cultural property and assists only those projects that are sited or designed so as to prevent such damage.

OP/BP 4.10 Indigenous Peoples (July 2005)

Indigenous peoples in particular geographical areas are identified by having: a close attachment to ancestral territories and to the natural resources in these areas; self-identification and identification by others as members of a distinct cultural group; an indigenous language, often different from the natural language; presence of customary social and political institutions; and primarily subsistence-oriented production.

The Bank's objective is to to ensure that indigenous peoples do not suffer adverse effects from Bank financed projects and that they receive culturally compatible social and economic benefits. Effectively the World Bank requires a project to develop a program for addressing issues based on

the informed participation of the indigenous people themselves. Any project that affects indigenous peoples is expected to include components or provisions that incorporate an "Indigenous Peoples Development Plan".

OP/BP 4.12 Involuntary Resettlement (December 2001)

Details involuntary resettlement, emphasizing the severe economic, social and environmental risks, if unmitigated. It ensures that the population displaced by a project receives benefits from it and also covers those with usufruct or customary rights to land or other resources taken for the project. The Operational Policy is specifically inclusive, ensuring that all those affected both directly and indirectly by project developments are compensated as part of the project. Affected population, include those with income derived from informal sector and non-farm activities, and from common property resources. The absence of legal title does not limit rights to compensation.

The World Bank's Policy objectives urge that involuntary resettlement be avoided whenever possible. If unavoidable, displaced persons need to:

- share in project benefits,
- participate in planning and implementation of resettlement programs, and
- be assisted in their efforts to improve their livelihoods or standard of livings or at least to restore them, in real terms, to pre-displacement levels or levels prevailing prior to the beginning of project implementation, whichever is higher.

OP 17.50 Disclosure

This Policy details the Banks requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including nongovernmental organizations, is essential for the effective implementation and sustainability of projects.

2.6 International Agreements

Ethiopia has ratified the following international conventions and protocols pertaining to the environment and which are of relevance to the Project:

- United Nations Framework Convention on Climate Change, 1992
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal adopted on 22 March 1989
- Bamako Convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, adopted 30 January 1991
- Convention on Biological Diversity, 5 June 1992
- United Nations Convention to Combat Desertification (UNCCD), adopted 1997
- Convention on the Protection of World Cultural and Natural Heritage, ratified 1997.
- Convention on the Means of Prohibiting and Preventing the Elicit, Import, Export and Transfer of Ownership of Cultural property, ratified 2003.

Sudan has ratified the following international conventions and protocols pertaining to the environment and which are of relevance to the Project:

- Convention on Biological Diversity, 1992
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Framework Convention on Climate Change, 1992

- Bamako Convention on Trans - boundary Movement of Hazardous Waste
- Vienna Convention (ozone layer depletion)
- Montreal Protocol
- Ramsar (wetlands) Convention
- Kyoto Protocol

The ratified treaties become part of the national laws and their provisions prevail in case of contradictions with the provisions of the national laws. Accordingly, the Sudanese courts apply the provisions of the international treaties in issues raised before the courts. As a result of Sudan becoming a party to some treaties, it has received help in the preparation of a National Strategy and Action Plan on Biodiversity, Sudan's National Communication on Climate Change and National Action Plan to Combat Desertification.

The institutions responsible for the implementation and monitoring compliance to both national and international agreements include:

- The Higher Council for Environment and Natural Resources (HCENR);
- Ministry of Environment and Physical Development (MEPD);
- Federal Ministries of Health, Industry and Agriculture;
- Ministries and Councils at state level.

3 Project Description

3.1 Overview

The Ethiopia-Sudan transmission interconnection Project's long-term development objective is to promote regional power trade through coordinated planning and development of power generation and transmission interconnections in the context of multi-purpose water resources development. The immediate objective is to facilitate cross-border power trade between the two countries and thus optimise utilization of existing and planned generation capacity. The expected output is a high-voltage transmission line connecting the two countries, which would be the first step in realizing an integrated power system in the Eastern Nile.

3.2 Location and Justification

The study area includes North and South Gonder Zone and Eastern and Western Gojam Zone in Amhara Regional State, Eastern and Western Wollega and West Shewa Zones in Oromiya Regional State, Metekel and Assosa Zones in Benishangul-Gumuz Regional State in Ethiopia and the Al-Qadarif and An-Nil Al-Azraq (Blue Nile) States in central-eastern Sudan. The area is situated between 34^0E and 38^0E longitude and 8^0N and 14^0N latitude and falls within the Abbay (Blue Nile) Catchment (Figure 1).

The 1995 Feasibility Study was updated in 2005 by Hifab Oy Consultant. The outcome of the technical/economic update was a recommendation for a 245 kV double circuit transmission line 446 km in length from Bahir Dar to Gonder (Azezo) Substation in Ethiopia linking with the El Gedaref Substation in Sudan. The transmission line would consist of self-supported steel lattice towers. A ROW of 40m in width along the transmission route was also recommended.

The section from Bahir Dar to Gonder would only require upgrading of the existing single circuit line with construction of a new single circuit line running parallel to it. Similarly, the section from Gonder to Shehedi would require upgrading of the single circuit line now under construction by EEPCO. The towers have been designed to accommodate another circuit so that new towers would not be required for this section of Option C. A completely new double circuit line with supporting towers is required from Shehedi in Ethiopia to El Gedaref in Sudan.

The following line route options were considered in the feasibility update. Their location is shown in Figure 2.

- Option A: Gedo-Nekemte-Gimbi-Kurmuk-Roseires (614 km)
- Option B1: Debre Markos-Injibara-Border-Roseires (448 km)
- Option B2: Bahir Dar-Injibara-Border-Roseires (425 km)
- Option C: Bahir Dar-Gonder (Azezo)-Shehedi-Metema-Gallabat-El Gedaref (446 km)

Although all of the above options will form the basis of this ESIA investigation, greater attention will be given to Route C, which the Feasibility Update recommended as the preferred route.

The main objective of the Project is to increase reliability of supply in the two Countries by taking advantage of the hydro-thermal complementarity of the two systems, and the variability of the peak demand. In addition, the two countries may trade not only energy but also reserve capacity. The interconnection line is envisaged to support investments in infrastructure that will facilitate the coordinated interconnection facilities between Ethiopia and Sudan, and thus start to remove physical constraints to the integration of the power systems. It is also foreseen that the Project could be the first step towards regional power markets to utilize the enormous energy resources of the Eastern Nile Area (hydropower, geothermal, gas and oil).

Initially, Project benefits would come from replacing thermal generation, based on indigenous oil in Sudan, with Ethiopian surplus hydropower. Sudan can sell this saved oil and oil products to Ethiopia and other international markets. The interconnection line would also make it possible for the countries to coordinate and optimise the release of water from their hydropower dams. This would be important especially when Merowe hydropower project is completed in 2008.

3.3 Route Description Option C

The Project route is located in South and North Gonder Zones (within Ethiopia) and crosses nine woredas, namely Bahir Dar, Libo Kemken, Fogera, Maksengit, Gonder, Chilga, Dembia and Metema. The proposed transmission line will pass over agricultural lands that are located at both high and lowland levels. For the most part, the project alignment will follow the Bahir Dar-Gonder-Metema and Sudan Road. Within Sudan, the route continues along the Metema to El Gedaref road via Gallabat (also referred to as Qallabat) on the Sudan border and the village of Doka. The landscape along this section of the route is uniformly flat lowland plains dominated by agricultural lands with occasional higher grounds. A more detailed description of the environment is provided in Section 4.

EEPCO, through the contractor ENERGO INVEST, is in the process of constructing a single circuit transmission line from Gonder to Shehedi within Ethiopia. A detailed survey plan of the route within Ethiopia was thus available for use by the ESIA team. The route alignment within Sudan follows the general alignment of the road from Gallabat on the Sudan-Ethiopia border to Gedaref.

3.4 Description of Proposed Works

The proposed works include the construction of a 230 kV (highest operation voltage is 245 kV) double-circuit transmission line with lattice steel towers and all aluminium alloy conductors (2-450 mm^2 cross-section) from the existing Bahir Dar substation in Ethiopia to a new substation at Gedaref in Sudan. Since the existing single circuit line between Bahir Dar and Gonder (Azezo) cannot accommodate another circuit on the same towers, this section of the route will require construction of a new single circuit line which will run parallel to the existing one. The double circuit is required for security of supply.

Between Gonder and Shehedi the single cicuit line currently under construction by EEPCO has been designed to accommodate a second circuit so this section of Option C will utilise the same towers for stringing of another circuit line. A completely new double circuit line with steel towers will be required from Shehedi in Ethiopia to El Gedaref in Sudan.

Most of the construction activity during Project implementation will involve the erection of the transmission line. The line will use self-supported steel lattice towers with concrete foundations as commonly used in Sudan and Ethiopia.

The new substation proposed for Gedaref is part of an upgrading of the electricity distribution network for the Region and provision will be made to accommodate two additional incoming lines should the Ethiopia-Sudan Power System Interconnection Project proceed with Option C route.

Basic information for the Bahir Dar to Gedaref line is:

1. Total Line Length Bahir Dar to Gadaref Sub-station: 446 km (150km in Sudan and 296km in Ethiopia)
2. Approximate number of towers: 915 (603 in Ethiopia and 312 in Sudan)
3. Approximate average span length: 0.5 km
4. Width of line corridor ROW: 40m
5. Design and fabrication of materials (6 months)
6. Total construction time: September to September, 12 months, multiple work teams
7. Total labour: about 400-500 persons
8. Access road: a 5m wide path along the line route will be required for repair and maintenance in the absence of a public road.

With respect to the minimum clearance between line conductors and ground or other objects, the respective power authorities have nationally adopted specifications. NEC uses the IEC Standards and Codes as their national specifications which ensure safety from direct electric shocks and flashover to humans and animals.

3.5 Ancillary Facilities and Services

The following construction and post-construction facilities and services will be required.

- Tower erection, this follows tower foundation excavation/construction and uses the same area used by civil works.
- Approximately 7 construction material storage and camp areas will be required (Contractor to determine actual number), each approximately 5ha in area.
- Access for stringing of conductors is along the line corridor.
- Access to tower sites will be via the line corridor whenever possible to reduce the number of temporary access roads required during construction.
- A number of permanent access roads will be required for maintenance purposes along the transmission line route.

3.6 Operation and Maintenance Activities

Line Route (ROW)

A permanent area (40m in width, i.e. 20m clear of the route centre line) of land will be required to accommodate the transmission line, when completed. A parallel strip of land through those sections of the route which pass through vegetation shall be completely cleared. The width of the strip may vary according to the mean height of the vegetation and shall be determined by ensuring that any standing tree would not cause flashover from a conductor deflected up to 45° from the vertical. In determining the flashover clearance and in estimating the mean height of the vegetation due allowance shall be made for seasonal growth. In addition, any tree that may fall in the direction of the overhead line shall be cleared unless located more than 20 m plus the height of the tree clear of the route centre line.

Routine maintenance is carried out along the ROW to ensure the appropriate clearances between towers, conductors and vegetation and other objects are maintained according to the required safety/operation specifications listed above. A 5m wide path along the line route will be required in the absence of a public road. Maintenance is normally carried out twice a year (dependent on site conditions).

Substation Maintenance

An ongoing maintenance program will be required for the substations. This will involve periodic replacement of coolants/lubricants in the transformers. Both EEPCO and NEC have indicated that they will no longer use transformers containing PCBs (as commonly used in old equipment) which are toxic to the environment and humans. They also have agreed to a program of replacing old transformers and disposing of any hazardous/toxic materials in accordance with international best practice. Both countries are signatories to international conventions on the use and control of hazardous substances (refer to Section 2.6).

3.7 Area of Impact

The area of immediate impact will be the Line corridor Right-of-way (ROW) which will be 40m in width by 446 km in length from Bahir Dar in Ethiopia to Gedaref in Sudan. A parallel strip of land through those sections of the route which pass through vegetation will also be completely cleared of all trees, scrub and undergrowth above a height of 150mm during the construction stage. Appropriate clearance between conductors and vegetation/structures along this corridor will be maintained throughout the life of the transmission line. Cropping and grazing beneath the conductors is normally permitted.

Tower foundations will require a permanent area of approximately 7m x 7m (49m^2) based on a typical 220 kV line tower. The temporary area required during tower foundation construction will be 10m x 10m. Tower foundation materials and equipment will be stored in the area reserved for stringing along the line corridor.

Additional temporary land will be required for worker camps and storage of construction materials during the dry season as well as the line corridor.

3.8 Project Implementation

In line with similar projects implemented in Sudan and Ethiopia, construction is expected to start after contract signing following international competitive tendering. Pre-construction activities associated with design work include soil investigations and detailed survey of the transmission line route and substation location. Actual mobilization for construction work will follow within six months of final design. The mobilization period includes activities for preparation of material storage areas, camps, water, power, communication and other site facilities.

Construction of the transmission line will then start by preparation of tower foundations, followed by tower erection and conductor stringing. Minor work will be required within the substations at Gonder and Gedaref to connect the conductors to the electricity grids within Sudan and Ethiopia.

The dominant land use along the transmission line route is rain fed agriculture and crops are normally grown only during the rainy season from June-October. The land is left to fallow and/or used for grazing during other times of the year. During this period and due to the absence of paved roads it will not be possible to transport material or to carry out construction work. Also during heavy rains it will be very expensive to properly store building materials, especially cement.

For these reasons most of the site works will proceed during the dry season November-June, when there is no cultivation. This will facilitate construction and reduce impact on crops to a minimum. Working during the dry period will also provide job opportunities for local people after the busy cultivation season.

The project is planned to be completed within 20 months from the date of signing of contracts (planned for 2007) assuming construction takes place only during the dry season and it will take approximately 18 months for equipment design, fabrication, delivery, erection and testing.

3.9 Project Cost

The total Project cost calculated on April 2005 value and allowing for 10% physical contingency and using an average inflation of 5% per year is 57.64 million Euro (Hifab Oy Consultant, 2005). This value assumes Option C is chosen and includes costs for both Sudan and Ethiopia.

It also includes a cost of 1.5 million Euro for the mitigation program for environmental and socio-economic impacts of the Project, covering compensation for the loss of permanent and temporary assets and an environmental monitoring program. This figure needs to be revised slightly higher to reflect cost estimates calculated during the ESIA and RAP studies.

A detailed breakdown of costs associated with compensation for lost assets of project affected people is given in the RAP Reports for Sudan and Ethiopia. Environmental monitoring cost estimates are given in Section 7 of this Report.

4 Baseline Data

Ethiopia is a country of great geographical diversity. Agriculture is the main stay of the economy that provides for about 80 % of the population and contributes about 50% of the GDP and 90 % of the export. The major environmental problems in Ethiopia are land degradation as a result of unsustainable use of natural resources. The impact of which has now manifested in the high rate of soil erosion in rural parts of the country owing to high population growth, large-scale deforestation, overgrazing, loss of biological resources and recurrent drought.

Sudan is dominated by flat plains, generally below 1,000m, broken by rolling hills and the Project area skirts the foothills of the Ethiopian Highlands. The Project area is within the Blue Nile and Atbarra river systems which rise in Ethiopia. Much of the area is under agricultural cultivation and livestock farming including cattle, sheep and goats. Important crops include irrigated cotton, sorghum, wheat, rice, sesame, groundnuts, oilseeds, and gum Arabic. Unsustainable land use practices have contributed to land degradation and increasing desertification. The resultant loss of habitat combined with hunting pressures has also contributed to the loss of many larger mammals and restricted their distribution to southern Sudan and protected areas such as Dinder National Park, located south of Gallabat (Figure 2).

4.1 Methodology

The methodology for collection of bio-physical and socio-economic information for the Project area has been described in Section 1.5. In summary, detailed surveys have been undertaken for the preferred route (Option C) and rapid surveys undertaken for the alternative routes (options B1/B2 and A). Field work has been supplemented by reference to secondary data sources including published/unpublished reports, maps and photographs.

Limitations

The time allocated initially to undertake the study was effectively 3 months (August to October, 2005) to mobilise staff, plan field work and carry out field investigations (including stakeholder consultation) and draft report write-up for all three Options. This time was extended by 1.5 months in 2006 to allow collection of baseline information following survey of the alignment for sections of Option C from Bahir Dar to Gonder and Shehedi to Metema in Ethiopia and from Gallabat to Gedaref in Sudan.

The study was further complicated by working during the rainy season in both Sudan and Ethiopia making access difficult to many areas. Route A in Sudan and a small section of route B between Mankush and Bambudie at the Sudan border could not be accessed during this time and the Consultant had to rely on secondary data sources, principally topographic maps and other reports such as the environmental investigation for the heightening of Roseires Dam (Gaafar 1994). Work in Sudan during 2005 was further complicated by having to carry out field work during the religious month of Ramadan. Nevertheless, the Consultant is confident that sufficient information has been collected to adequately assess the environmental and social impacts of the Project and to justify selection of Option C as the preferred route.

4.2 Physical Environment

Reference to study area in the following Section refers to the area in Sudan and Ethiopia covering all three route options as described in Section 3.2.

4.2.1 Topography and Geology

The topography along Option C route from Bahir Dar to Gonder (Azezo) to Metema in Ethiopia and to Gedaref in Sudan varies greatly from the high plateaux area above 2,000 m around Gonder to the lowland plains (around 500m to 900m in altitude) towards the Ethiopian-Sudanese border at Metema and then on to El Gedaref in Sudan.

Between Bahir Dar, the start of the route and Gonder, the landform varies from flat plains at around 1,780 masl in the vicinity of the Abbay River near Bahir Dar to high mountains above 2,300masl at Tara Gedam Mountain in the Kulkul Ber Mountain range.

The section from Gonder to Metema passes through an undulating landscape, starting at about 2100masl at Gonder, moving to lower ground and reaching 1770masl about 30km from Azezo and rising to 1970 masl at about 40km from Azezo, and reaching the escarpment and entering the Tembera Valley and reaching the bottom of the valley at Sinkur river, 1100masl 100km from Azezo. From there on the route meanders through the lowlands to Metema, continuously loosing altitude to reach 860masl at Metema, about 170km from Azezo.

Debre-Markos, the start of Route Option B1 is located at an altitude of 2550masl, and the planned route varies in altitude from as high as 2550 at Debre-Markost to 900masl near Mankush. The altitude increases up to Amanuel, falls to 2000masl at Temcha River before rising again to 2100 at Dembecha then gradually falling to 1900masl at Jigga and rising to 2300 masl near Kosso-Ber/Injibara). From then onwards there is s declining trend from at Injibara to 900masl at Mankush on the Sudanese Border. The route is generally flat except till one reaches the escarpment past Chagni where there is a sharp fall in altitude. The rest of the route, both in the lowlands (past Pawe) and the highlands (Debre-Markos to Chagni) passes through undulating hills and gentle slopes.

According to the Ethiopian Mapping Authority (1988), Precambrian rocks with ages of over 600 million years are the oldest types of rocks in the country and form the basement on which younger formations lie. The Precambrian includes a wide variety of sedimentary, volcanic and intrusive rocks that have been metamorphosed to varying degrees. In the southern and western parts of the country where they are predominantly granites and gneisses, they have been more strongly metamorphosed than their counterparts in the north.

The geological formation in the eastern and upper parts of the Abbay Basin (Bahir Dar area) is Tertiary and Quarternary volcanic origin belonging to the older Trap series and the younger Aden series (BCEOM 1998). These have formed the rolling basaltic volcanic highland plateau which was formed from a series of rapid, massive flows that extended great distances from the central vent areas. The volcanic formations have a general slope which is oriented westward.

The Abbay basin has been widely influenced by the Precambrian tectonic activity that resulted in the formation of the Rift Valley system throughout eastern Africa. There is evidence of considerable tectonic activity on the plateau itself where the courses of some rivers have largely determined by faulting as well as the grabben in which Lake Tana is located.

Based on the information obtained from the Geological Map of Ethiopia, the area from Debre-Markos through Kosso-Ber/Injibara to Chagni are also of volcanic origin, while most of the parts west of Chagni are of Precambrian origin. The geology of the area between Gonder to Metema is of volcanic origin (Ethiopian Mapping Authority, 1998).

Although topographically, the Oromiya and Benishangul-Gumuz Regions (Option A route) are characterized by diversified landforms: extensive mountain ranges, dissected plateaus, hills, undulating and rolling plains, deep gorges and valleys, most of the area can be classed as lowlands, below 1,500 masl (Benishangul-Gumuz National Regional State (BGNRS) GIS data base, 2005).

Generally Al-Qadarif State in Sudan (Route C traverses this State) is considered as a flat plain, being part of the Sudanese central clay plain. However, El Gedaref town is located on a plateau forming a water divide between the Atbara River to the east and the Rahad River to the west. Geologically, the following formations are found (Gaafar 1994):

a) Basement complex which is the most extensive formation and consists mainly of igneous and metamorphic rocks with few outcrops in Gala' El Nahal, Fau Jebels and Gadambaliya.

b) Nubian Series covers appreciable areas and known as Gedarif formation. This formation consists of sandstones, mudstones and sand – mudstones and occurs around El Gedaref and along the Ethiopian border.

c) Volcanic rocks are found in the Gedarif formation. Out crops of the formation are found on ridges around the towns of El Gedaref and Qallabat.

d) Superficial deposits cover rocks of all formations. These are the result of decomposition and disintegration of volcanic rocks. They are mostly dark cracking clays where mechanized rain-fed farming is practiced.

Routes A and B are found in the Blue Nile State which, in many ways, exhibits similar characteristics to the area traversed by route (C). The surface of this area is shaped by active water erosion as only remnants of the basement complex can be observed as out crops. The area is flanked by the Ethiopian highlands to the east and Ingassana Hills in the west. The area between those hills is sloping gently towards the Blue Nile. The area is traversed by many Wadis and streams and gullies. The main geological formation is a basement complex composed of gneisses in which bands of marble and mica schist are found (Gaafar, 1994). The main morphological features include: the clay plain which is part of Sudan's central clay plains; the Blue Nile terraces with flat topography in many areas; the Piedmont plain which occupies gentle slopes at the foothills that surround the southern part of the study area, where seasonal water courses dissect the area and flow towards the Blue Nile.

4.2.2 Soils

Shallow stony soils are commonly found on the plateaux areas and on hilly areas within the lowland plains while black cracking clays dominate the lowland plains, particularly in Sudan. While the black soil types are good for cropping, they make access to the area during the wet season very difficult. Soil erosion/degradation is a major problem such that it contributes to the low level of agricultural productivity in Ethiopia and increasing desertification in the Sudan.

El Gedaref State as described earlier is a vast plain of deep, dark cracking clays. The origin of the soil is believed to be the Ethiopian Highlands or as the result of decomposition of rocks in situ as those found around the towns of Gedaref and Doka. (Gaafar 1994).

Similarly, the soils of route Option B within Sudan are also dark cracking clays, high in clay content (>60% clays). These soils are very sticky and shrink when dry and become very hard with a high water holding capacity. In some areas, local names are used to describe the soil types found. In the areas to the east of Roseires, large areas are described as Azaza soils composed of clay and gravel. To the east towards the Ethiopian border, large tracks are described as Badoba soils – cracking and non–cracking clays.

The soil along Option C route in Ethiopia varies with the topography. In the higher altitude where there is intensive cultivation, the soil is predominantly blackish clay with stone mulches. Gravels and pieces of stone along the route on farms and open land indicate that the soil is relatively non erodable, and as a result no serious gully formation was observed. In contrast, Lithosols occur as shallow soils on ridges and slopes particularly in the Tara Gedam, Kulkur Ber and Gonder areas. They are prone to drought, water logging and high runoff and are highly susceptible to erosion. Vertisols occur on both low, poorly drained plains such as the Forgera Plain and on rolling hill areas. They have good natural fertility and are intensively used for agriculture and livestock grazing in the dry season.

For route Option B, Western Gojjam is dominated by Nitosols, while in the lowlands of Metekel, Latosols and Grumosols are predominant (Ethiopian Mapping Agency, 1998).

A diverse range of soil types with differing fertility status and agricultural potential are found in the Oromiya Region, however, the Region suffers from deforestation which has lead to significant soil erosion problems (Bureau of Finance and Economic Development, the National Regional State of Oromiya, Ethiopia, 2004).

4.2.3 Climate

The variation in altitude is the primary cause of variation in climate in Ethiopia, as elsewhere in the tropics; the lower the altitude the higher the temperature. Proximity to the equatorial monsoonal systems is also an important influencing factor on the climate. The rainfall in the study area also varies. The climate within the study area is tropical where there is no significant variation in day length and the angle of the sun throughout the year. Similarly, the lack of altitude in Sudan

accounts for the lack of variation in climate. The study area belongs to a Type I Rainfall Regime characterized by one rainy season (Gamechu, 1977).

The highlands in Gojjam (including Debre-Marcos), Wollega and also in the bordering lowlands in Illubabor, Wollega and part of southwest Gojjam experience seven rainy months (April to October), comprising of small rains (April and October) and the main rainy season (May to September), highest concentration is in July, August and September.

The highlands of Gonder, Wollo and Tigray Zones, as well as, the lowlands in Gonder Zone (including Metema) and Gojjam West (Benishangul–Gumuz Region)have five months of rain(May to September) with the highest concentration in July and August. Mean annual rainfall varies from 1450mm at Bahir Dar and generally decreases towards the Gonder area (900mm) and towards the lowlands around Metema.

Most of Metekel Zone (Benishangul-Gumuz Region, Ethiopia) is found in the wide and fertile Beles Valley. Chagni, at the head of the main valley, is at 1,620masl and has a mean annual temperature of 19.5ºC (mean minimum 12ºC, mean maximum 27ºC). The high rainfall is due to a special orographic condition with the funnelling of the wet western winds along the Beles Valley towards the escarpment where they are forced to rise and drop their rain. The main rains come as one long season from May to October with another small peak in January and February. The lowland plains between Guba and the Sudan border to the north of the Abbay River are broken by small hills.

Metema Woreda (Amahara Region, Ethiopia) has three main rivers, the Dinder in the south, the Atbara in the middle, which leaves Ethiopia at Metema, and the Angereb on the northern border with Tigray Region. The altitude at Metema is 803masl and it has a mean annual temperature of 27.8ºC (mean maximum 35.9ºC, mean minimum 19.5ºC. Rainfall is less than 900mm a year falling mainly from May through to September.

Further south, in the Benishangul-Gumuz Region (Option A), the duration of the rainy season decreases from south to north. According to the classification of rainfall regimes given by National Metrological Service Agency Benishangul-Gumuz lies in the Region which is characterized by a wet season from April/May to October/November.

In addition to the latitude, the altitude has a considerable influence on the amount of precipitation, which increases with increasing altitude. Thus, Assosa, with an altitude of 1,550m, has an average annual precipitation of 1,275 mm, whereas, an area with an altitude of 700 m, only gets 860 mm rainfall.

Temperature reaches a daily maximum of 20-25^{0}C in the dry season and the hottest period is from February to April. The minimum temperatures range from 12^{0}C to 20^{0}C, depending on season and altitude (BGNRS GIS data base, 2005).

Temperatures within the Oromiya Region also vary greatly depending on the altitude, although in general, there is a mean seasonal temperature range of 15-20^{0}C (Bureau of Finance and Economic Development, the National Regional State of Oromiya, Ethiopia (2004). South westerly winds cause summer rain in which the highlands of the Region in particular receive the highest rainfall. The Gimbi area receives a mean annual rainfall of around 2,000mm while on the Sudanese border the mean annual rainfall can be as low as 1200mm (Bureau of Finance and Economic Development, the National Regional State of Oromiya, Ethiopia, 2004).

In Sudan, the climate is characterised by two main traits; sustained heat and marked seasonality of rainfall. The year is characterised by a dry season with high temperatures and a wet season with high relative humidity which may reach the value of 79% in August. The coldest month is December, when temperatures may be as low as 8.7 C°. During the warmest month of April temperatures may be as high as 44 C°. Rainfall is confined to five months (May, June, July, August and September). However, rainfall varies in intensity and amount from year to year. In Al-Qadarif State, the average annual rainfall ranges from a minimum of 322 mm to a maximum of 761 mm. Generally, the eastern and southern areas close to the Ethiopian border receive higher amounts of rainfall than the northern parts of the state where El Gedaref town is located, which is part of Sudan's semi–arid belt.

In the Blue Nile State, meteorological records for Damazin, Roseiris, and Kurmuk also reflect the variability of rainfall. The average annual rainfall for the above three towns is 712 mm for Damazin, 713 mm for Roseiris and 988 mm for Kurmuk (Gaafar, 1994).

4.2.4 Surface and Groundwater Resources

The study area lies within the catchment of the Abay or Blue Nile and the Atbara river systems. Many of the watercourses flow only during the rainy season from April/May to September/October. Outside these times many watercourses are reduced to intermittent pools. Access to potable (drinking) water supplies is often a problem during the dry season especially on the lowlands in Sudan and in Ethiopia near the border with Sudan. Local villagers rely on groundwater wells and small shallow dams (wadis/hafirs in Sudan) for water supply during these times.

In the Blue Nile State, there are four sources of surface water:

- The Blue Nile River.
- Khors and seasonal streams.
- Rain water collecting in natural depressions.
- Hafirs.

Groundwater in Al Qadarif State is found in what is called the Gedarif formation and in areas underlain by Nubian Sandstone as well as in weathered and fractured tertiary lava. Recharge of these aquifers is mainly from the Setit River and from seasonal streams (Gaafar, 1994). The area is traversed by many seasonal water courses. In addition to the Atbara and Rahad Rivers, there are two major Khors, namely Khor Abu Farga and Khor Magadeem.

In the Blue Nile State, there are three potential sources for underground water:

- The quaternary cover of clays, sands and gravel forming flat plains to the east and west of the lake created by Roseiris Dam. Groundwater is available in these flat plains comparable to the Gezira formation.
- Groundwater is available in the alluvial sediments of recent and old channels.
- Groundwater is also available in fractured zones in Basement Complex rocks.

Literature on groundwater is limited and the potentials are not tapped. Hence, at present, most of the inhabitants depend on shallow - dug wells and Hafirs.

Several perennial and seasonal rivers/streams drain the study area. These streams are usually the source of water supply for human as well as domestic animal consumption and other uses, such as cleaning, bathing, and recreation (swimming). Major rivers along route Option B include the Kulech, Temecha, Birr, Aysika, Bengez, Gublak, Enat Beles, Gilgel Biles and Addi. Route C crosses the Dirma, Guang, Awga, Gint, Sinqur, Belwuha, Boketa, Derek Abay, Abat Meka, Girar, Gendwuha, Zingrit, Megech, Gumera and Ribb Rivers.

The section of Route C from Bair Dar to Gonder lies within the catchment of Lake Tana, the largest freshwater lake in Ethiopia and which is fed by over 60 rivers and streams flowing from the Simien Mountains to the north, the large Central Plateau to the east and the gentler sloping land to the west (EWNH 1996). Extensive wetlands occur around the lake shore and at Forgera Plains.

The Forgera Plains are bounded by the Ribb and Gumera Rivers to the north and south of the Plains respectively. The area is a vast naturally flooded area that is also influenced by the drawdown of Lake Tana. Habitats provided include open water, papyrus and reed beds, farmland, shrub lands, forest patches and homesteads. The forgera plains are a natural wet grasslands. The transmission line route crosses the eastern part of the Forgera Plains.

West Oromiya is endowed with abundant water resources. Its major surface drainage systems include the Abay (Blue Nile), Ghibe and Baro catchments, with minor ones at Fincha's and Gilgele Ghibe's catchments. Despite this, the number of people who have access to potable water is very low. In 1994, it was estimated that 77.8 of the population of the Sub-Region did not have access to

potable water. The distribution of potable water varies in the different zones. A 2001/2002 survey estimated that 28% of people in East Wellega received potable water, of which 19.1 were rural and 90.1 were urban. In West Wellega, some 7.3% of the population received potable water, of which 44.2% were urban and 3.2 rural (Sub-Regional Atlas of West Oromiya 2004)

The Benishangul-Gumuz Region has potentially rich surface and sub-surface water resources. However, little has been done to utilize these resources. In 1997, only 19% of the population had access to potable water, a statistic which was raised to 37.21% by 2003.

4.3 Biological Environment

The physical environment described above created conditions for diverse types of vegetation, life forms, and influenced the type of human activity in the study area. In general, the biological environment is greatly altered and changed as the result of natural factors and human activities. Frequent cycles of drought, flood and other natural hazards played major roles in the process of change that affected the life forms in the study area. Equally, the spread of mechanised rain-fed agriculture and the pattern of traditional land use triggered the process of desertification with adverse consequences on forests, wildlife, biodiversity and the natural ecological systems of the study area.

The following sections provide details on the present status of the biological environment. Information presented is based on published/unpublished information sources and field survey work carried out in the Sudan and Ethiopia by the Consultant's staff during September and October 2005 and February 2006. The survey work in 2006 was undertaken for the Bahir Dar to Gonder section of Option C. Most bird and plant species were identified during the field observation. A field guide was used for the confirmation/ identification of bird species (Williams and Arlott, 1992). A field guide to the Mammals of Africa was used for the identification of mammals seen during the study (Haltennorth and and Diller, 1977). Published volumes of the Flora of Ethiopia and Eritrea (Hedberg and Edwards, 1989; Edwards et al., 1995; Hedberg et al., 1997; Phillips, 1995) were used for the identification of plant species. Plant specimens were also collected to verify correct identity of unique species and those that were not in flower.

4.3.1 Vegetation

Land use and vegetation cover have been strongly influenced by the climate, topography and population. Few if any undisturbed natural forests remain, most have been heavily disturbed and degraded. Forest types range from natural forest, plantation forest (mainly introduced Eucalyptus trees), farm forest (Eucalyptus) and Acacia woodland/savannah. Vegetation associations have been disturbed by human activities and changes in hydrology (water regimes). Many road verges have also been planted with introduced Eucalypt trees and these trees are gradually spreading into remnant native vegetation.

4.3.1.1 Vegetation of Option C

The list of plant species encountered during field survey along this route is shown in Appendix 4. The vegetation along this route consists of Dry Evergreen Afromontane Forest and Grassland, *Combretum-Terminalia* woodland and in depressions and adjacent to water courses, riverine and swamp vegetation. Due to intensive human activities, intact vegetation cover is limited to a few protected areas such as state forests and forests around churches and monasteries.

Dry Evergreen Afromontane Forest and Grassland

The Dry evergreen Afromontane Forest and Grassland vegetation type covers the area between Gonder at about 12°33'6.9''N 37°25'32.4''E, 2130 m altitude up to a distance of 68 km towards Metema descending to Tembera valley at about 12°31'16.3''N 36°58'12.6''E and 1800 m altitude. It consists of mainly trees such as *Acacia abyssinica*, *Albizia gummifera*, *Allophylus abyssinicus*, *Arundinaraia alpina*, *Croton macrostachyus*, *Erythina brucei*, *Juniperus procera*, *Maytenus obscura*, and *Olea europaea* subsp. *cuspidata*. The shrub layer includes *Calpurnia aurea*, *Carissa edulis*, *Maytenus serrata* and *Rosa abyssinica*.

Combretum – Terminalia Woodland

The Combretum – Terminalia woodland vegetation type covers the area west of about 68 km towards Metema at about 12°31'16.3''N 36°58'12.6''E and below1800 m altitude up to Metema at about 12°57'09.3''N 36°09'18.5''E at bout 850 m. It consists of mainly trees such as *Anogeissus leiocarpa*, Thus the area hosts a diversity of unique flora *Combretum collinum, Combretum hartmannianum, Entada abyssinica, Entada Africana, Erythrina abyssinica, Pterocarpus lucens, Strychnos innocula, Terminalia collinum, C. molle, C. rochetiana, C. hartmmanianum, Stereospermum kunthianum*. The shrub layer includes *Grewia mollis, Maytenus sengelensis*, etc. There are also a number of herbaceous plants including grasses such as *Pennisetum polystachion, P. ramosum, P. schweinfurthii* and *Sorghum arundinaceum*.

Riparian and Swamp Vegetation

This vegetation type consists of at least two physiognomic ally different types, riverine and riparian forest, and open, almost treeless vegetation. Typical trees in the riverine forest association are *Acacia polyacantha, Breonadia salicina, Phoenix reclinata, Sapium ellipticum*, and *Tamarindus indica.*

Low Rainfall Woodland Savannah

The route for Option C passes through Al-Qadarif State in Sudan. Harrison and Jackson (1958), in their important study "Ecological Classification of the Vegetation of Sudan", placed Al-Qadarif State in two sub–divisions of Woodland Savannah (Low Rainfall Woodland Savannah and High Rainfall Woodland Savannah). Woodland Savannah is described as any mix of vegetation composed of grass, bushes and trees, which is characteristic of tropics with a monsoon rainfall confined to a few months.

The type of vegetation found in the Low Rainfall Woodland Savannah is low trees or bushes with thorns. Annual grasses dominate and there is a low diversity of species. The Low Rainfall Woodland Savannah is further divided into two belts according to soil types; on dark cracking clays of Central Sudan and on stabilised sand dunes of Western Sudan. Each soil type gives rise to specific types of vegetation. The whole of Al-Qadarif State lies within the Low Rainfall Woodland Savannah on clays. Hence, the types of vegetation on clays include: *Acacia mellifera* alternating with grasses in the drier parts of this zone (annual rainfall 100–570 mm) and *Acacia seyal – balanites* alternating with grasses where annual rainfall is between 570 and 800 mm. The dominant tree species in the *Acacia mellifera* zone include *Cadaba glandulose*, *Cadaba rolundifolia* and *Boscia senglensis* with some *Balanites aegyptiaca*. The most abundant grasses include *Cymbopogon nervatus*, *Sorghum pupures* and *Setaria verticillata*. In eroded and gully areas, the dominant tree species include *Acacia nubica, Acacia raddiana* and *Capparis deciddia*, while the grasses include annual *Aristida* species, Se*hoenefeldia gracilis* and *Sporbolus* (Harrison and Jackson, 1958).

The *Acacia mellifera* zone gradually merges into *Acacia* seyal/A. *balanites* zone at about 570 mm isohyets. Cultivation removes *A. seyal* and *A. balanites* is left as a pure stand. *Acacia senegal* is also found but not as pure stands unless under plantation. The dominant grasses are *Sorghum purpureo, S. soriceum, Hyparrheria pseudocymbaria* and *Cybopogon nervatus*.

The northern part of Al-Qadarif State is predominantly pastoral area with good rangelands for camels, sheep and goats. The southern part of the State is predominantly agricultural in the form of mechanised rain–fed farming. The expansion of agriculture has disturbed the traditional transhumance pattern of the pastoral tribes.

Common species associated with river banks include *Tamarix nilotica* (Tarfa) with scattered trees of *Acacia abida* (Haraz) and *Zizyphus spinachristi* (Sidir). In the shallow depressions (Mayaas), species such as *Acacia nilotica* (Sunut) water grasses and water lettuce are found. Occasional trees and short grasses are found in gully areas. In areas described as Azaza soils, tree species such as *Combretum hartmannianum* (Habeel) and *Peterocarpus angolense* (Taraya) occur. The hills and rocky outcrops, support species such as *Stercuila setigera* (Tartar). Species such as *Mespilirformis* (Goghan) and *Hyphaene thebaica* (Dom Palm) occur along the seasonal streams.

Unique Vegetation

In the highlands in the Dry Evergreen Afromontane and Grassland, there is an endemic shrub, *Maytenus serrata*, only known from Gojjam, Gonder and Tigray floristic regions. In the lowland, in the *Combretum-Terminalia* woodland, there are two important tree species and one grass species that are restricted to the Gojjam and Gonder floristic regions in Ethiopia and adjacent eastern parts in the Sudan. The tree species are *Combretum hartmannianum* and *Combretum rochetianum* and the grass species is *Pennisetum schweinfurthianum*. Between Bahir Dar and Gonder there is an important state forest of Tara Gedam and adjacent to the forest is a dense primary forest around Tara Gedam Monastery. These areas are considered as a "priority forest area" in the Amhara Region because of their importance as a seed source for the Olea tree. Thus the region hosts a diversity of unique flora.

4.3.1.2 Vegetation of Option B (B1/B2)

The list of plant species encountered during field survey along this route is shown in Appendix 4. The vegetation along this route ranges from Dry Evergreen Afromontane and grassland, *Combretum-Terminalia* woodland and in depressions and adjacent to water courses, riverine and swamp vegetation in Ethiopia to Low Rainfall Woodland Savannah along the Sudanese lowlands.

Dry Evergreen Afromontane Forest and Grassland (Photograph 3)

The Dry Evergreen Afromontane Forest and Grassland vegetation type covers the area between Debre-Markos and Chagni. The vegetation type consists of mainly trees such as *Acacia abysinica*, *Albizia gummifera*, *Allophylus abyssinicus*, *Arundinaraia alpina*, *Borassus aethiopum*, *Croton macrostachyus*, *Erythina brucei*, *Juniperus procera*, *Olea europaea* subsp. *cuspidta*, *Maytenus obscura* and *Podocarpus falcatus*. The shrub layer includes *Calpurnia aurea*, *Carissa edulis* and *Rosa abyssinica*.

Combretum – Terminalia Woodland (Photograph 1)

The *Combretum – Terminalia* woodland vegetation type covers the area almost west of Chagni to Mankush. It consists of mainly trees such as *Anogeissus leiocarpa*, *Boswellia papyrifera*, *Combretum collinum*, *Combretum hartmannianum*, *Cussonia ostinii*, *Entada abyssinica*, *Erythrina* abyssinica, Pterocarpus lucens, Strychnos innocula, Oxythenantera abyssinica, Terminalia *collinum*, *Sterospermum kunthianum*. The shrub layer includes *Grewia mollis*, *Maytenus sengelensis*, etc. There are also a number of herbaceous plants including grasses such as *Pennisetum polystachion*, *P. ramosum*, *P. schweinfurthii* and *Sorghum arundinaceum*.

Riparian and Swamp Vegetation (Photograph 4)

This vegetation type consists of at least two physiognomic ally different types, riverine and riparian forest, and open, almost treeless vegetation. Typical trees in the riverine forest association are *Acacia polyacantha*, *Breonadia salicina*, *Phoenix reclinata*, *Sapium ellipticum*, and *Tamarindus indica*. This vegetation type includes perennial or temporary wetlands with sedges, *Lemna minor* and *Ceratophyllum* sp.

Low Rainfall Woodland Savannah (Photographs 2 and 5)

Within Sudan, Option B route passes through the Blue Nile State. Ecologically, the whole Blue Nile State lies within the Low Rainfall Woodland Savannah on clays with annual rainfall between 300–800 mm. Within this wide range of rainfall, various types of tree species are observed as the result of changes in topography and soil texture. *Acacia seyal* (Talh) and *Balanites aegyptica* (Heglig) are dominant with tall grasses such as *Huperrhenia pseudocymberia* (Anzora), *Sorghum nigra* (Adar), *Cymbapogon nervatus* (Nal) and *Ischemum brachyatherum* (Bous) from the understorey or dominate cleared areas. However, in the drier parts of this zone (500–700 mm rainfall), species such as *Acacia mellifera* (Kitir) and *Acacia senegal* (Hashab) occur in association with grasses, *Aristida* Spp., *Eragrostis* Spp. and *Schoenfeldia gracilis*. In the hill slopes and well drained sites, species like *Combretum hartmannianum* (Habeel), *Anogeisus leiocarpus* (Sahab), *Enatada sudanica* (Layun), and *Boswellia papyrifera* (Tarag – tarag) are found with a mixture of short and tall grasses as understorey (Gaafar, 1994).

Unique Vegetation

A number of unique species are present along this route. A particular herbaceous plant, *Chlorophytum serpens* that is found at about 70 km between Chagni and Mankush was recently described (Sebsebe Demissew *et a*l., 2005). There are two important tree species (*Combretum hartmannianum* and *Combretum rochetianum*) and one grass species (*Pennisetum schweinfurthianum*) that are restricted to the Gojjam and Gonder Regions in Ethiopia and adjacent eastern parts in the Sudan. *Borassus aethiopum* is one of the largest palms in Ethiopia, its fruits are eaten and the leaves are used for making mats and this palm is known from other parts of moist tropical Africa, but with a patchy distribution. Thus the area hosts a diversity of unique flora.

4.3.1.3 Vegetation of Option A

The Benishangul-Gumuz Region is known for its endemic lowland bamboo forests (*Oxytenanthera abyssinica*), incense trees (*Boswellia papyrifera*) and caster oil (locally referred to as Noug), all of which have important investment potential. Extensive stands of the solid-stemmed lowland bamboo (*Oxytenanthera abyssinica*) between Asossa and Kurmuk and also south of Assosa were observed during field inspection of Route Option A (Photograph 6).

Oromiya Region has high forest, woodland, riverine, shrub and bush, Juniperus forest (at higher altitudes), Acacia and plantation forests (Bureau of Finance and Economic Development, the National Regional State of Oromiya, Ethiopia, 2004). Much of Option A route passes through broadleaf forest areas of Aningeria and Olea which have been disturbed through cultivation and livestock grazing.

Within Sudan, Opotion A route passes through similar vegetation (Low Rainfall Woodland Savannah) to that found along Option B route within the Blue Nile State and described in Section 4.3.1.2 above.

4.3.2 Wildlife

Land clearing, land degradation and large stock numbers have also taken their toll on the study area's biodiversity and although vegetation types are diverse, they are severely degraded. Similarly, the area's wildlife diversity has been significantly reduced, especially with respect to the larger mammals. The diversity of bird species has also been reduced though many endemic species (occurring nowhere else) still occur in Ethiopia.

The Blue Nile (Options B and A pass through this State) and Al-Qadarif States (Option C passes through this State) in the Sudan were known for their variety of wildlife. The Savannah ecosystem provided good habitat for a variety of game including antelopes, buffaloes, giraffes, big cats, monkeys and a diversity of birds (Gaafar 1994). Within this ecosystem, the distribution of wildlife is influenced by availability of drinking water, habitat suitability and routes of migration. Human impacts (direct through hunting and indirect through habitat destruction in both States has reduced the wildlife diversity such that many species are now confined to a few protected areas such as the Dinder National Park (located between Option B and C routes, Figure 2). The area of this park covers parts of the Blue Nile and Al-Qadarif States and extends to the Ethiopian border to the east. Outside the Dinder National Park area, the game which used to be seen some years ago can hardly be observed nowadays (Gaafar 1994). During field work for this study, none of the wildlife mentioned above were observed except for a variety of birds which were observed in abundance. The main factors that have led to the disappearance of wildlife include:

- Expansion of mechanised farming;
- Disappearance of forest resources;
- Poaching activities by sedentary and nomadic tribes as well as poachers.
- Blocking of seasonal migratory routes of wildlife by farming activities.
- The opening of the Rahad Game Reserve for farming activities.
- In the Blue Nile area, particularly along the route leading to Kurmuk (Option A), the civil war contributed to the loss of wildlife.

Studies have shown that even within the protected area of Dinder National Park, wildlife populations are in decline and a number of species are endangered or extinct (HCENR 2003).

It is important to note that none of the proposed route options (C, B and A) passes through the Dinder National Park.

4.3.2.1 Wildlife of Option C

In Ethiopia, several species of large wild animals have been reported from the area (Appendix 4). However encounters with large mammals during the present field study was very rare. This is not surprising since there has always been an ongoing conflict between wildlife conservation and increasing demand on land for agricultural and livestock development. These growing and ongoing conflicts must be seen within the context of the levels of chronic poverty, which existed and still exists throughout Ethiopia, especially rural Ethiopia. Wildlife cannot survive if it constantly has to compete with human interest in the form of cultivation and livestock raising that invariably cause wildlife habitat destruction. The study area is no exception to this process.

With the exception of birds (see Section 4.3.3), only a limited number of wildlife species with low population sizes are found along this route in Ethiopia. Areas with steeper slpoes that are less utilised for human activities and with good vegetation cover provide relatively good habitat conditions for wildlife particularly for primates and small antelope species such as duker.

Mainly those wild animals which are adapted to survive in disturbed habitats are found in the area. Animals reported to be present include: primates such as the Anubis baboon and vervet monkey, bush duiker (‘Midagua’), bush back (‘Dilkula’), common fox (‘Kebero’), porcupine (‘Jart’), wild pig (‘Assama’), spotted hyena (‘Jib’), hare (‘Tinchel’), Cheetah (‘Aner’) and ‘Shekoko’. Of the few wildlife habitats, Tara Gedam Forest between Bahir Dar and Gonder provides relatively better protection for wildlife. Other important areas include Kulkul Ber Forest and forests around churches.

Big game hunting in the lowlands of Metema and Metkel was a common pastime of the nobility of the adjacent highlands in Gojam and Gonder during the 19th and early 20th centuries. Wildlife is often perceived as a self-sustaining natural resource, and has been hunted for food and/or recreation without paying due respect to conservation. Wildgame comprised normal food source of the Gumuz hunter gatherers of the past, both in Metema and Metekel, and to a lesser extent to some community members at the present time.

4.3.2.2 Wildlife of Option B (B1/B2)

The Ethiopian Wildlife and Natural History Society (EWNHS) has identified important bird areas in the Awi Zone, a zone that route B traverses (Debre Markos-Finote Selam-Injibara-Chagni-Guba). The zone is located at $10^0$38’-$11^0$04’N/$36^0$17’-$37^0$16’E, with an area of 1,318,440ha. The sites identified include Zimbri Marsh, Zengena Lake, Dunkina and Apini Forests and Goodbill Forest and Pond.

During a 1995 survey of the Awi Zone, a total of 214 bird species were recorded, of which 28 belong to the Highland biome. Two globally threatened species were recorded, Rouget’s Rail and the Ethiopian endemic Abyssinian Longclaw. Other Ethiopian endemics recorded were Abyssinian Woodpecker, and Abyssinian Catbird, both Highland biome species. White Rumped Babbler and Bush Pertronia were noted, as well as a number of Palaearctics (EWNHS, 1996). Notable birds recorded from Dukima and Apini Forest during the survey includes Highland biome species: Abyssinian Ground Thrush and Abyssinian Crimson Wing. The numbers of species recorded are tabulated below (Table 2). Four sites, each with different qualities and habitat types having characteristics, which contribute to the overall richness of the natural biodiversity in Awi Zone (Agaw) were identified.

TABLE 2. NUMBERS OF BIRD SPECIES RECORDED FROM SITES IN AWI ZONE IN OCTOBER 1995

Site	Total	HB	E	Altitude (masl)
Zimbri Marsh	96	12	0	2,300-2,350
Zengena Lake	28	8	8	2,480
Dukima and Apini Forests	100	18	2	2,500
Goobil Forest and Pond	69	15	2	2,400-2,500

HB=Highland biome, E= Endemic (Source: EWNHS, 1996)

4.3.2.3 Wildlife of Option A

The natural resource base of the West Oromiya Region in particular supports a number of Wildlife Reserves and Conservation Areas, although none would be affected by the route. Lion, Colobus Monkeys, Civet and otter have been recorded as occurring within the area of the proposed transmission route (Bureau of Finance and Economic Development, the National Regional State of Oromiya, Ethiopia, 2004). Numerous Colobus Monkeys and Baboons as well as a Civet (road kill) were seen whilst driving along the Gedo to Asosa road during the present study.

4.3.3 Areas of Ecological Importance

The areas of ecological importance within the Project area include some protected forest areas, Lake Tana and Forgera Plains in Ethiopia and the ecologically important Dinder National Park in Sudan. Dinder National Park is located between Roseires Reservoir and the town of Gallabat. The Ethiopian-Sudanese border forms its Eastern boundary. The National Park originally included an area north of the Rahad River up to the town of Gallabat but the Sudanese Government annexed this area from the Park and opened it up to farming following pressure from local farmers. The Rahad River now forms the northern boundary of the Park. The closest National Park in Ethiopia is Gambela National Park but it is located well south of the Option A route. Figure 2 shows the location of these National Parks.

Lake Tana and the Forgera Plains have been identified as important bird areas (IBAs) by the Ethiopian Wildlife and Natural History Society (EWNHS) on the basis of the presence of 5 globally threatened species (Wattled Crane, Lesser Flamingo, Rouget's Raid, Pallid Harrier and Greater Spotted Eagle), high waterbird populations (over 20,000 seasonally) and the recording of 19 highland biome species in the area. Two localities within the Forgera plains, Shesher Welala and Wagetera have the highest species diversity and population of birds in the area. These sites are situated approximately 9km and 15km west of the proposed transmission line route.

Lowland bamboo forests occurring in Ethiopia are also ecologically important and are being lost to land clearing and exploitation by local people. The proposed routes for Options B and A pass through lowland bamboo forests.

As described earlier, the lands traversed by the proposed three routes in Sudan are either under farming or rangelands. Natural forest is depleted as the result of rain-fed mechanised farming.

4.4 Socio-cultural Environment

The RAP study has provided the basis for this information.

The proposed transmission line routes under consideration run through the Amhara, Oromiya and Benishangul-Gumuz Regions of Ethiopia, and the Al Qadarif (El Gedaref) and An-Nil al-Azraq (Blue Nile) States of Sudan (See Figures 3, 4 and 5).

The main ethnic group in the Amhara Region is Amhara, with minor representation of the Weto, Hemra and Agew. In the Oromiya Region, the major group is Oromo, with minor representation of Amhara, Gurage and other smaller groups. In the Benishangul-Gumuz Region, the Gumuz, Berta,

Oromo and Amhara people can be found. The majority are Amharigna and Oromiffa speakers, although other languages are spoken too. The major religious affiliations are Christianity and Islam.

By contrast, the ethnic profile of east central Sudan is extremely diverse. The two States are inhabited by a mix of sedentary agriculturalists, and nomadic or semi-nomadic pastoralists. Amongst the latter category are also the Ingessana, Falatta, Fulani, and Umbararo ethnic groups who originate from Nigeria, and the Dinka who, more recently, have sought refuge in the area from the war in southern Sudan. Although Sudanese Arabic is spoken by most people throughout these two States, the area is remarkable for its linguistic diversity. While the majority are adherents to the Moslem faith, Christianity and a range of indigenous spiritual traditions are also practiced.

The majority of Ethiopians and Sudanese in the given areas are dependent upon land as the basis of socio-economic subsistence.

In the Amhara Region of Ethiopia, for instance, agriculture accounts for 63.1 percent of the regional GDP, and nearly 90% of the population derives its livelihoods from agriculture and allied activities (Bureau of Finance and Economic Development, 2004). Crop production in the form of cereals, pulses, oil seeds, fibres and root crops, and animal husbandry are the major agricultural activities in the region. Although the area is known for its various water resources and irrigable land potentials, the majority pursue rain fed agriculture.

The predominant agricultural practice in east central Sudan is rainfed mechanized farming. This type of farming was introduced by the British in the mid-1940s and has continued to dominate agricultural production in the region. The investment requirements for mechanised farming favours prosperous cultivators, and most farms are operated by entrepreneurs from urban centres. Private companies have also been officially allocated land, and in the 1970s, state farms amounted to some 7.5% of all mechanized farming.

Cultivation practices have generally shaped the settlement profiles in the two countries. In Ethiopia, where small-scale subsistence farming is the predominant agricultural practice, farmers tend to be located on their properties which are scattered across the countryside. Where roadside villages occur, families tend to take advantage of commercial opportunities presented by through-traffic by establishing shops, coffee houses and other complementary income-generating activities. Social services in the smaller villages may amount to a Primary School only, and are therefore negligible. Most of the larger towns, on the other hand, will have some kind of health service facility (e.g. a clinic or dispensary) and other social services (e.g. a high school, community centre, prison, veterinary clinic, etc.).

The settlement profile in Sudan is quite different from that in Ethiopia, determined largely by the commitment of large tracts of land to mechanized farming. Most people tend to live in villages or towns. They will commute daily to their lands or, if farm labourers, to their places of employment. Like Ethiopia, smaller villages are provided with the minimal health and educational services, while larger towns (e.g. Doka and Ed Damazin) have a more developed social services infrastructure. In general, however, the Project affected areas in Sudan are extremely under-serviced.

4.4.1 Administrative Framework

4.4.1.1 Option C

Option C is located in South and North Gonder (Azezo) Zone of the Amhara Regional State of Ethiopia. It commences at the substation in Bahir Dar traverses through five Woredas, namely Bahir Dar, Libo Kemkem, Fogera, and Maksengit to the town of Gonder (Azezo). From Gonder (Azezo), it proceeds through four woredas, namely Gonder (Azezo) Zuria, Dembia, Chilga and Metema.

Al-Qadarif State is located in eastern Sudan. It shares international borders with Eritrea in the northeast and with Ethiopia in the east and southeast. It covers an area of about 75263 km sq. Administratively, Al-Qadarif State is divided into three localities, namely Northern Gadaref,

Gadaref and Gallabat. The Gallabat locality (Project affected area) consists of five administrative units (see table below). Its administrative capital is Doka.

TABLE 3. LIST OF ALL ADMINISTRATIVE ZONES ALONG ROUTE C ALIGNMENT

Region/State	Zone/Locality	Woreda/ Administrative Area	Towns
Amhara Region, Ethiopia	South Gonder	Bahir Dar	Bahir Dar
		Dera	Dera
		Libo	Libo Kemkem
		Fogera	Wereta
		Maksengit	Maksengit
	North Gonder	Gonder (Azezo) Zuria	Gonder (Azezo) /Azezo
		Chilga	Aykel
		Dembia	Kola Diba
		Metema	Shehedi Metema
Al-Qadarif State, Sudan	El-Gallabat Locality		Gallabat
			Doka
	Al-Gedaref Locality		Gedaref

4.4.1.2 Option B1/B2

The project area commences in the west of Ethiopia. The transmission line route passes through the West and East Gojam zones in the Amhara Regional State, and the Metekel zone of Benishangul-Gumuz Regional State. In Sudan, it traverses eastern An-Nil-al Azraq State, commencing at the border village of El Mahal on the Ethiopian-Sudanese border, and terminating at the Roseires substation in the Ed-Damazin administrative locality.

The An-Nil al-Azraq State is divided into five localities namely Ed-Damazin, Roseires, Kurmuk, Bau and Geisen. It has one administrative unit, and the capital city is Ed-Damazin.

TABLE 4. LIST OF ALL ADMINISTRATIVE ZONES AND TOWNS ALONG THE ROUTE OPTION B1 ALIGNMENT

Region/State	Zone/Locality	Woreda/ Administrative Area	Town
Amhara Region, Ethiopia	East Gojam	Debre Markos	Debre Markos
		Gozamin	Chemoga
	West Gojam	Machakil	Amanuel
		Dembecha	Yechereka
			Dembecha
			Addis Alem
		Jabi Tinan	Finote Selam
			Jiga
			Mankussa
		Bure Wemberima	Bure
			Shendi
	Awi	Banja Shikudad	Enjibara
			Kosso Ber
			Kessa
			Tilili
		Guangua	Chagni
Benishangul-Gumuz Region, Ethiopia	Metekel	Mandura	Genete Mariam
		Gilgel Beles	Gilgel Beles
		Guba	Mankush
		Pawe (sp. Woreda)	Pawe
An-Nil al-Asraq State, Sudan	Ed-Damazin	Ed-Damazin	Menza
			Umjinigir
			Azaza
			Roseires
			Damazin

Source: CSA Statistical Abstract, July 2004

4.4.1.3 Option A

This proposed route spans two Regions in western Ethiopia – namely, Oromiya and Benishangul-Gumuz - and the An-Nil al-Azraq (Blue Nile) State in eastern Sudan. The route commences at the substation in Gedo and connects the towns of Nekemte, Ghimbi, Assosa and Kurmuk in Ethiopia to the Sudanese substation in Roseires. It is the longest route Option, with the tie-line totalling some 614 kilometres.

TABLE 5. LIST OF ADMINISTRATIVE ZONES ALONG ROUTE OPTION A ALIGNMENT

Region/ State	Zone/Locality	Woreda/ Administrative Are	Towns
Oromiya Region, Ethiopia	Mirab (West) Wellega Zone	Mana Sibu	Mendi Kiltu Kara
		Nejo	Nejo Gori Wara Jiru
		Ghimbi	Ghimbi Homa
	Misrak (East) Wellega Zone	Lalo Asabi	Inango Dongoro
		Sibu Sire	Sire
		Guto Wayu	Nekemte Gute
		Sasiga	Galo Arb Gebeye Ehud Gebeye Tsige
		Diga Leka	Gatama Arjo Gudetu Diga
Benishangul-Gumuz Region, Ethiopia	Assosa	Menge	Menge
		Kurmuk	Kurmuk
		Assosa	Assosa
		Komesha	Komesha
		Sherkole	Holma
		Bambesi	Bambesi
		Oda Godere	Oda Buldigilu
An-Nil Al-Azraq (Blue Nile) State, Sudan	Ed-Damazin		Roseires

4.4.2 Demographic Features

4.4.2.1 Option C

The total population of the Amhara Region was estimated at 18 million in 2004. This accounts for 25.5% of the population of Ethiopia, while the Region only covers 15.4% of the landmass of the country. The overwhelming majority of the population resides in rural areas (+89%) and is engaged in agriculture. Population distribution is uneven among zones and Woredas, however, and generally the highlands are more densely populated than the lowlands.

TABLE 6. POPULATION ESTIMATE BY TYPE OF RESIDENCE, AMHARA REGION

Residential Area	Total Population			2005 Estimates
	Male	Female	Total	
Rural	8,186,295	7,970,585	16,156,880	16,564,096
Urban	913,832	1,083,074	1,996,906	2,097,003
Total	**9,100,127**	**9,053,659**	**18,153,786**	**18,661,099**

Source: Population Team of BoFED, 2004

TABLE 7. POPULATION ESTIMATE AND DENSITY IN SOUTH AND NORTH GONDER, AMHARA REGION, 2004

Zone	Total Population	Area (km²)	Density (per km²)
North Gonder Zone	**2,949,217**	**48621.28**	**60**
South Gonder Zone	**1,196,133**	**14320.08**	**83**
Bahir Dar Special Zone	**182,562**	**1176.72***	**155**

Source: Annual Statistical Bulettin of ANRS BoFED, 2003 * Bahir Dar Woreda Planing and finance office.

The population growth rate of the Region is 2.9 % per annum with an average population density of 99.80 per km/sq. In the Project affected area specifically, population density is 87.88 per km/sq. (Population Department: Bureau of Planning and Economic Development, September, 2001). The average family size in the Project affected area is 5. The table below shows some of the demographic variables of the Project affected area.

TABLE 8. DEMOGRAPHIC CHARACTERISTICS OF THE PROJECT AREA (ETHIOPIA)

Woreda	**Population**			**Family Size**	**Population Density (Per km²)**
	Urban	Rural	Total		
Bahir Dar	182,562	---	182,562	5	155
Dera	18,380	237,973	256,353	5	162
Fogera	28,818	212,670	241,488	4.8	74
Lib Kemkem	25,487	92595	118,082	5	156
Maksengit	25,744	231,035	256,779	5	
Gonder Zuria	28,367	242,151	270,517	‘’	174
Dembia	31,915	274,756	306,671		211
Chilga	17,375	217,241	234,616	4.8	74
Metema	19,964	60,598	80,562	4	21

Source: Woreda Sector Offices, 2006

Around 88.84 % of the population in Amhara is under 15 years in age, and 5.23% are over 60 years. This indicates a high dependency burden. Life expectancy rates have dropped to 43 years.

Infant mortality rates are relatively high: 112/1000 live births. One out of every 10 babies dies before the age of one (Development Indicators of the Amhara Region, 2003/2004).

In the last census of Sudan (1993), the population of the Al-Qaradif State was estimated to be 1,022,000, with an average population density of 17 persons per km/sq. and an annual growth rate of 3.45%. The high growth rate of the State is due partly to waves of immigrations from the neighbouring countries and other states of Sudan, either as refugees, or who are attracted by the potential for employment in the agricultural sector.

TABLE 9. POPULATION OF AL-QADARIF STATE (2000-2004)

Year	**2000**	**2001**	**2002**	**2003**	**2004**
Male	759,342	785,106	812,127	839,243	864,420
Female	706,570	730,542	755,685	780,917	804,344
Total	**1,465,912**	**1,515,648**	**1,567,812**	**1,620,160**	**1,668,764**

Source: Economic Review & Strategic Planning Council, Al-Qadarif State

Some 71% of the total population resides in rural areas, and most of them are concentrated in the southern and south eastern localities of Fashaga and Gallabat where the proposed transmission line route is located. The urban population represents some 29% of the regional population.

TABLE 10. RURAL AND URBAN POPULATIONS OF THE STATE (2000-2002)

Area/Year	**2000**	**2001**	**2002**	**Percentage**
Urban	428,046	442,569	457,801	29
Rural	1,037,866	1,076,679	111,001	71
Total	**1,465,912**	**1,519,248**	**568,802**	**100**

Source: Administration of Statistics, Al-Qadarif State

TABLE 11. DISTRIBUTION OF THE STATE POPULATIONS ALONG THE ROUTE ALIGNMENT

Locality	2000	2001	2002	Percentage
Gadarif	129,000	13,377	137,967	9
Gallabat	413,387	427,413	444,124	28.3
Fashaga	451,501	466,820	482,886	31
Rahad	279,990	289,488	249,452	16
Fao	142,034	198,550	205,383	13.1
Total	**1,415,912**	**1,395,648**	**1,519,812**	**97.4***

Source: Administration of Statistics, Al-Qadarif State
** The remaining 2.6% of the population are considered nomads*

The population of the state is composed of a number of different ethnic groups. The major groups include semi-nomadic people such as the Shukriya, who occupy the western and the southwest parts of Butana; the Lehaween, who live along the River Atbara and are both livestock owners and cultivators. Other groups include Kawahla, Fur, Hamar, Masaleet, Beni Amir, Fallata, Kenana, Barno, Zabarma, and a number of minor groups who have migrated from northern and western Sudan.

4.4.2.2 Option B1/B2

Amhara and Benishangul-Gumuz Regions have a population of 18,626,000 and 610,000 respectively (25% and 1% of the country's population). In both regions, the rural population predominates. Rural dwellers in Amhara constitute some 88.8% of the Regional population, and 90.3% in Benishangul-Gumuz.

TABLE 12. POPULATION BY SEX FOR AMHARA AND BENISHANGUL-GUMUZ REGIONS, 2005

Region	Town			Rural		
	Male	Female	Total	Male	Female	Total
Amhara	1,048,00	1,049,000	2,097,000	8,261,000	8,268,000	16,529,000
Benishangul-Gumuz	30,000	29,000	59,000	277,000	274,000	551,000
Total	1,078,000	1,078,000	2,156,000	8,538,000	8,542,000	17,080,000
Ethiopia	5,803,000	5,872,000	11,675,000	30,802,000	30,567,000	61,369,000

Source: CSA Statistical Abstract, July 2004

Table 12 above indicates rural and urban populations by sex for the country, and for Amhara and Benishangul-Gumuz Regions more specifically.

Recent statistics are not available for the An-Nil al-Azraq (Blue Nile) State. However, the 2003 estimates show that the total population of the State is 696,000, with average annual growth rate of 2.5%. Some 75% of residents live in rural areas.

The State has been affected by civil war, which has forced thousands to move within the State or cross the border into Ethiopia as refugees. The State has also received a large number of Internally Displaced Persons (IDPs) from Southern Sudan, who live in camps in Damazin, Gissan and Kurmuk. Table 13 shows some population characteristics of the State.

TABLE 13. SOME POPULATION CHARACTERISTICS OF THE AL-NIN AN-AZRAQ (BLUE NILE) STATE

Population Characteristics	Numbers
Total population	696,000
Rural population	75%
Urban population	25%
Internally Displaced Persons	41,705
Nomadic	N. A.

There are 12 Woreda in the Project affected area in the Ethiopia portion of Option B1, of which 8 are located in the Amhara Region and 4 in the Benishangul-Gumuz Region.

The Woredas in Amhara Region are characterized by a high population density that varies from 123 persons/km^2 in Machakil Woreda to 3,798-person km^2 in the town of Debre Markos. By contrast, the Woredas in Benishangul-Gumuz Region have very low population density, ranging from 2.7 person/km^2 in Guba Woreda to 85.3 persons/km^2 in Pawe (special Woreda). The following table depicts the total population of Woredas affected by the transmission line in Option B1.The total population is estimated to be 1,795,566 persons, of which 894,248 are men and 901,318 are women.

TABLE 14. POPULATION SIZE OF WOREDAS LOCATED IN OPTION B1 BY SEX, AREA AND DENSITY

Region	Zone	Woreda	Population by Sex			Area in Sq. Km	Density
			Males	Females	Total		
Amhara	East Gojam	Debre Markos	41,298	40,477	81,775	21.53	3,798.2
		Gozamin	124,835	127,034	251,869	1,704.73	147.7
	West Gojam	Machakil	124,488	126,628	251,116	2,035.63	123.4
		Jabi Tinan	132,363	132,392	264,755	1,230.94	215.1
		Dembecha	60,784	60,751	121,535	847.18	143.5
		Bure Wemberima	143,288	145,483	288,771	2,207.20	130.8
	Awi	Banja Shikudad	100,361	102,827	203,188	832.51	244.1
		Guangua	101,391	101,333	202,724	2,161.63	212.3
Benishangul -Gumuz	Metekel	Dangur	20,247	20,757	41,004	8,387.19	4.9
		Guba	5,169	5,419	10,588	3,896.10	2.7
		Mandura	15,364	14,447	29,811	1,003.76	29.7
		Pawe (Special Woreda)	24,660	23,770	48,430	567.51	85.3
Total			**894,248**	**901,318**	**1,795,566**		

Source: CSA Statistical Abstract, July 2004

Like that of B1, the Woredas that are located within the Option B2 alignment in the Amhara Region are characterized by high population density. Table 15 depicts the total population of Woredas affected by the proposed transmission line in Option B2. The estimated population of the Woredas is about 1,269, 673, of which 641,702 are men and 627,971 are women.

TABLE 15. POPULATION SIZE OF WOREDAS LOCATED IN OPTION B2 BY SEX, AREA AND DENSITY

Region	Zone	Woreda	Population by sex			Area in square km	Density
			Male	Female	Total		
Amhara	Bahir Dar	Bahir Dar	82,498	77,295	159,793	28.0	5,706.9
	West Gojam	Bahir Dar Zuria	134,036	129,365	263,401	2,062.62	127.7
		Achefer	161,325	156,717	318,042	2,515.64	126.4
		Merawi	163,072	163,129	326,201	1,602.81	203.5
	Agew Awi	Dangila	100,771	101,465	202,236	1,504.63	131.3
Total			**641,702**	**627,971**	**1,269,673**		

Source: CSA Statistical Abstract, July 2004

Tables 16 and 17 indicate population statistics of the Al-Nin Al-Azraq (Blue Nile) State in Sudan. The first profiles population density in the State as a whole, and the second focuses on the eastern Roseires Reservoir area more specifically.

TABLE 16. POPULATION OF THE AN-NIL AL-AZRAQ (BLUE NILE) STATE BY LOCALITY (2000)

Locality	Number	Percentage (%)
Damazin	234,452	39%
Roseiris	166,457	28%
Kurmuk / Gissan	76,760	13%
Bau	120,941	20%
Total	598,610	100%

Source: Gaafar, 1994

TABLE 17. POPULATION BY AGE AND SEX DISTRIBUTION FOR SUDANESE REGION (EAST ROSEIRES RESERVOIR AREA) 1994

Age group	Males	Females	Sex Ratio
0<1	285	291	97.9
1-4	3960	3994	99.1
5-14	7184	6888	104.0
15-34	6352	7109	89.4
35-49	2340	2245	104.1
50-59	758	633	119.7
60+	1246	858	145.2
Total	22125	22018	100.

Source: Gaafar, 1994

A number of urban and administrative centres in Ethiopia will be crossed by the transmission line. The major urban centres affected in Option B1 include Debre Markos, Finote Selam, Bure, Dembecha and Chagni. In addition to the major towns listed in Table 18 below, there are a number of small towns that will be affected by the transmission line. The urban population in the Project affected area is estimated to be about 223,393.

TABLE 18. POPULATION OF PROJECT AFFECTED TOWNS ON OPTION B1

Region	Woreda	Town	Male	Female	Total
Amhara	Debre Markos	Debre Markos	39,525	38,663	78,188
	Gozamin	Chemoga	421	524	945
	Machakil	Amanuel	4,678	4,597	9,275
	Dembecha	Yechereka	935	986	1,921
		Dembecha	6751	6957	13,708
		Addis Alem	1227	1324	2,551
	Jabi Tinan	Finote Selam	11,035	10,898	21,933
		Jiga	5788	6072	11,860
		Mankussa	2304	2229	4,533
	Bure Wemberima	Bure	10,546	10,729	21,275
		Shendi	4,063	4,425	8,488
	Banja Shekudad	Enjibara	566	623	1,189
		Kosso Ber	2,023	2,206	4,229
		Kessa	1058	1046	2,104
		Tilili	3,941	4,133	8,074
	Guangua	Chagni	15,319	14,238	29,557
Benishangul-Gumuz	Guba	Mankush	642	553	1,195
	Mandura	Genete Mariam	1,134	1,234	2,368
Total			**111,956**	**111,437**	**223,393**

Source: CSA Statistical Abstract, July 2004

In Option B2, the Project affected towns include Bahir Dar, Dangilla, Merawi and Dure Bete. The substation for this route is located in Bahir Dar. Table 19 below depicts the major urban centres within the B2 alignment by zone, Woreda and sex.

TABLE 19. POPULATION OF PROJECT AFFECTED TOWNS ON OPTION B2

Region	Zone	Woreda	Town	Male	Female	Total
Amhara	West Gojam	Achefer	Dur Bete	6,009	6285	12,294
		Bahir Dar Zuria	Meshenti	1,639	1,774	3,413
			Bahir Dar	82,498	77,295	159,793
		Merawi	Wetet Abay	2,219	2,503	47,22
			Merawi	6,920	7,718	14,638
	Awi	Dangilla	Dangilla	11,810	12,582	24,392
		Fagita Lekoma	Addis Kidame	2,834	3,328	6,162
	Total			**113,929**	**111,485**	**225,414**

Source: CSA Statistical Abstract, July 2004

4.4.2.3 Option A

Oromiya is the most populous Regional state in the country. Based on the 1994 Population and Housing Census, the projected population of the region was estimated at 23,704,000 at the end of 2002, accounting for over 35% of the population of the country. Out of the population of the region about 12.3 percent is estimated to dwell in urban areas, whereas the remaining 87.7% resides in rural areas.

The population of the region is characterized by high population growth, increasing at a rate of 2.9% annually. The age structure of the region shows that over 45% of the population is under 15 years of age, while the economically active age group is about 50%. The dependency ratio of the region is about 100, implying that for every 100 persons in the productive age group, there are 100 dependants (both young and old ages) to be supported.

The majority of the people in this Region belong to the Oromo ethnic group, followed by the Amhara. The dominant language spoken is Oromiffa, although Amharigna is widely spoken, irrespective of ethnicity.

TABLE 20. WESTERN OROMIYA: POPULATION SIZE BY SEX, AREA AND DENSITY BY REGION, ZONE, WOREDA AND TOWNS

Zone	Woreda	Towns	Male	Female	Total	Area (km^2)	Density
MIRAB (WEST) WELLEGA ZONE	Mana Sibu	Mendi Kiltu Kara	90,120	87,191	177,311	2,487.51	71.3
	Nejo	Nejo Gori Wara Jiru	71,016	73,619	144,635	984.07	147.0
	Ghimbi	Ghimbi Homa	70,383	72,791	143,174	1,183.44	121.0
MISRAK (EAST) WELLEGA ZONE	Lalo Asabi	Inango Dongoro	39,040	41,666	80,706	376.57	214.3
	Sibu Sire	Sire	46,241	48,897	95,138	1,132.51	84.0
	Guto Wayu	Nekemte Gute	114,463	116,244	230,707	1,324.22	174.2
	Sasiga	Galo Arb Gebeye Ehud Gebeye Tsige	30,099	30,928	61,027	938.13	65.1
	Diga Leka	Gatama Arjo Gudetu Diga	66,088	70,473	136,561	1,263.28	108.1

Source: FDRE Central Statistical Abstract (December 2004)

A large portion of the Region is drought prone which has caused periodic population dispersal. As the two zones within the Project affected area benefits from a reasonably reliable rainfall, it has been destined for the resettlement of large numbers of drought-stricken people from the east and northern parts of the Region.

Most of the towns in Oromiya Region, and West Oromiya in particular, have their origins with the expansion of Minilik and the Italian occupation, during which the major consideration for the selection of these sites was their military strategic importance (Physical and Socio-Economic Profiles of 180 Districts of Oromiya Region 2000). Subsequently, urban centres have been variously developed as administrative, commercial, cultural and transport centres.

The total population of Benishangul-Gumuz in July 2004 was measured at 593, 999 (FDRE Statistical Abstract 2004). Accordingly, some 92.2% of the population lives in rural areas and only 9.3% are urbanized. Most of the Region's inhabitants are sedentary cultivators who derive their livelihood from the production of cereals, root crops and cattle. Most inhabitants in the Assosa zone – the Project affected area - are hunter cultivators who derive their livelihood from a combination of small scale shifting agriculture, hunting wild animals and gathering wild fruit and tubers. Due to the shortage of surface water in this region, however, most of the settlements are

located near to permanent rivers. Animal herding, especially of cattle, is severely limited by the prevalence of the fly-borne disease, trypanosamiasis.

The indigenous people of Benishangul-Gumuz are the Oromiya, Gumuz, Berta, Shinasha, Mao and Komo. Due to the great famines of 1973/74 and 1983/84 in the northern and central part of Ethiopia, a large number of Amharic people from Welo were settled in the Region. Settlement patterns are thus determined by ethnic group and by culturally-prescribed livelihood practices. Most settlements are scattered, and many people live in remote and inaccessible areas. In some areas (e.g. Sherkole Woreda) people have begun to settle closer to centres where they may benefit from educational and health services. More recently, the Bureau of Agricultural Affairs (through the Office of Food Security and Resettlement) has embarked on a 'villagisation' programme which aims to accelerate the settlement of shifting cultivation or hunter-gatherer groups.

Although some towns have grown substantially in the past 10 years (e.g. Assosa), the rural-urban ratio has remained fairly consistent.

TABLE 21. BENISHANGUL-GUMUZ: POPULATION SIZE BY SEX, AREA AND DENSITY BY REGION, ZONE, WOREDA AND TOWN

Zone	Woreda	Towns	Male	Female	Total	Area (km^2)	Density
Assosa	Menge	Menge	18,644	19,034	37,678	1,500.63	25.1
	Kurmuk	Kurmuk	6,976	6,913	13,889	1,434.07	9.7
	Assosa	Assosa	51,942	48,074	100,016	1,991.41	50.2
	Komesha	Komesha	6,450	6,222	12,672	645.78	19.6
	Sherkole	Holma	8,843	9,322	18,165	3,204.22	5.7
	Bambesi	Bambesi	23,248	22,926	46,174	2,210.16	20.9
	Oda Godere	Oda Buldigilu	14,905	14,065	28,970	1,387.19	20.9

Source: FDRE Central Statistical Abstract (December 2004)

Main religions in Benishangul-Gumuz are Islam, Orthodox Christian and Protestant (Seven Day Adventist, Pentecost, Lutheran, Baptist, Anglican, Presbyterian, Meserete Kirstos, Mulu Wengel, Kale Hiywot), Catholic, and Traditional religions. The largest following is Moslem (44.1%), followed by Orthodox Christian (34.8%), Protestant (5.8%) and traditional (13.1%), (Facts about Benishangul-Gumuz National Regional State, 2003).

An-Nil al-Azraq (Blue Nile) State

The total population of the An-Nil al-Azraq State in 2003 was estimated at 696,000 persons, of which 74.6% were rural. The average household size in the state is 6.42. The sex ratio of males to females is 108.4 women per 100 men. The crude birth rate (1998-2003) is 38.5 per 1,000 live births while the crude death rate (1998-2003) is 12.3 per 1,000 live births. The annual population growth rate (1998-2003) is 3.01% (Sudan Transitional and Recovery Database, 2003). The main ethnic groups in the State are Burrum, Hamai, Fallata, Angasna and Funji.

One third of An-Nil al-Azraq State area is under Sudan Peoples Liberation Army (SPLA) control. The southern part of the State, mainly Kurmuk and Bau, have been affected by civil war for the past eighteen years and are under Government of Sudan / SPLA control.

TABLE 22. POPULATION OF AN-NIL AL-AZRAQ (BLUE NILE) STATE ACCORDING TO PROVINCES

Province	Population	Percentage
Ed-Damazin	234,452	39
Roseires	166,457	28
Kurmuk	76,760	13
Bau	120,941	20
Total	598.610	100

Source, Blue Nile State Encyclopaedia, 2000

4.4.3 Education

4.4.3.1 Option C

The Amhara Region has one of the lowest school participation rates in the country. According to the 1994 census, only 23.4% of the male and 12.0% of the female population were found to be literate. Literacy levels amongst rural dwellers are far lower than amongst urban residents.

According to the national education system, children between 4-6 years of age should be included in the kindergarten system. A 1998 study estimated that amongst the 1.42 million children in the Region, only 1.3% were enrolled in kindergarten.

The Region is characterised by its high population growth rate with an increasing school age population. According to population projections by the Population Department of BoPED, the number of primary school age children in 1999 was 3.2 million (BoPED 1998/99). From the academic year 1998/99 onwards, about 2716 primary schools have been providing basic education in the Region, and the gross enrolment ratio is 39.6%. During the 1998/99 academic year, there were 81 secondary schools and some 2286 teachers in the Region. The teacher-pupil ratio was measured at 1:43.

Some of the problems observed in the education sector in the Region are:

- Late entry to schools (prevalent in rural areas)
- Low efficiency and quality of teaching
- High drop-out and repetition rates at first and second cycle
- Low enrolment of females
- Student congestion at urban primary schools and all secondary schools
- Text book distribution is unevenly managed with a low ratio of text book to student
- Scarcity of teachers
- Lack of financial and physical resources
- Lack of direction and measures with respect to educational sector financing
- (Demographic and Socio-Economic Profile: Amhara Region, 2001)

TABLE 23. LITERACY RATE BY SEX, PLACE OF RESIDENCE, AMHARA REGION 2000

Region	Literacy Level in Percentage (%)		
	Rural	Urban	Total
Amhara			
• Male	26	80.7	30.9
• Female	9.7	57.2	15.6
• Both	17.9	66.9	23.1
National			
• Male	-	-	39.7
• Female	-	-	10.1
• Both	-	-	29.2

Source: CSA, Reports on the Year 2000 Welfare monitoring, 2000

Education indicators in the Sudanese State of Al-Qadarif are as follows:

TABLE 24. EDUCATION INDICATORS IN AL-QADARIF STATE

	Percentage (%)
Primary School enrolment (aged 6-13)	45
Literacy Rate (Male)	72.9
Literacy Rate (Female)	38.4

Source: Ministry of Education, Al-Qadarif State

TABLE 25. NUMBER OF SCHOOLS IN AL-QADARIF STATE

School Level	Number of Schools
Pre-school (kindergarten)	245
Elementary	503
Secondary	70

Source: Ministry of Education, Al-Qadarif State

TABLE 26. NUMBER OF SCHOOLS IN GALLABAT LOCALITY

School Level	Number of Schools
Pre-school (kindergarten)	48
Elementary	154
Koranic	12
Secondary	24

Source: Ministry of Education, Al-Qadarif State.

4.4.3.2 Option B1/B2

The educational level in both Project affected Regions in Ethiopia is extremely low. In Amhara, the primary school enrolment is 64.4% and the secondary level is at 19.3%. On the other hand, primary school enrolment in Benishangul-Gumuz is the highest in the country, and runs at about 98.4%. Despite high levels of enrolment, however, there is a high drop-out rate, which accounts for an 89% illiteracy rate amongst women above 10 years, and 79% amongst men of the same age (Regional Profile, Benishangul-Gumuz Regional State, 2004).

The Table 27 depicts primary and secondary school enrolment for the country by region and sex.

TABLE 27. SCHOOL ENROLMENT IN AMHARA AND BENISHANGUL-GUMUZ AND ETHIOPIA

Regions	Primary grade 1-8			Secondary grade 9-10		
	Both sexes	Boys	Girls	Both Sexes	Boys	Girls
Amhara	58.5	62.9	53.9	12.6	15.3	9.9
Benishangul-Gumuz	98.4	121.2	74.5	19.5	26.8	12.0
Ethiopia	64.4	74.6	53.8	19.3	24.0	14.3

Source: Ministry of Education (Education Statistics Annual Abstract 2002/03)

The 1993 Sudanese census result revealed that the Ed-Damazin administrative area suffers from poor educational attainment and poor educational infrastructure. The population is served by 24 elementary schools (six are closed) and no general or secondary schools. More than 55% of the population of age 7 and over are illiterate; only 2% completed their primary education.

TABLE 28. SCHOOL ENROLMENT RATE IN EASTERN ROSEIRES RESERVOIR AREA 1991

Region	Males	Females	Both Sexes
East Bank, Roseires	27.6	9.9	11.5
Average in Region	28.9	10.5	19.9

Source: Gaafar, 1994

4.4.3.3 Option A

In the last decade, encouraging strides have been made in the Oromiya Region to expand educational opportunities to hitherto unaddressed sections of the population. As a result, the gross enrollment ratio of the Region at primary level reached 61.8 percent in 2002, while at secondary level it was estimated to be 15.2 percent. Although, the extant achievement is remarkably high so far, a considerable number of children in the region nonetheless lack the opportunity to go to school. Generally, despite the concerted efforts that have been made in the region to expand education, the rate of literacy is still alarmingly low, standing at a mere 28%, lower than the national average of 35%. The literacy rate is found to be even lower among females (Regional Atlas of West Oromiya, 2004).

As Table 29 indicates, primary education is more accessible than secondary, and to date there are only 51 Secondary schools in West Oromiya. The table also indicates that the role of the private sector in education is indispensable.

TABLE 29. NUMBER OF PRIMARY AND SECONDARY SCHOOLS BY RURAL, URBAN AND BY TYPE OF OWNERSHIP 2002/2003

Number of Primary Schools by Rural, Urban and by Type Of Ownership, 2002/2003								
Zone	District	Urban	Rural	Total	%	Gvt	Non-Gvt	Public
West Wellega	20	57	430	487	30.0	470	11	6
East Wellega	21	45	312	357	22.0	354	3	0
Number of Secondary Schools by Rural, Urban and by Type Of Ownership, 2002/2003								
West Wellega	20	16	0	16		16	4	0
East Wellega	21	13	0	13		13	0	0

Source: Regional Atlas of West Oromiya (July 2004)

The educational status in the Benishangul-Gumuz Region is exceptionally low. According to the 1994 Population and Housing Census, it was estimated that the illiteracy rate was 82.1%. Although the Regional government has given considerable attention to the educational sector through the construction of Primary schools and the training of teachers, overall literacy levels have not changed significantly. Some of the conditions related to this problem are low quality education, high drop-out rates and uneven distribution of schools. In 2003 there were only 14 Secondary Schools in the Region providing secondary education to a mere 3.8% of the population (Facts About Benishangul-Gumuz National Regional State, 2003).

TABLE 30. SCHOOL ENROLMENT BY GENDER IN THE TWO PROJECT AFFECTED ETHIOPIAN REGIONS

Regions	**Primary grade 1-8**			**Secondary grade 9-10**		
	Both sexes	Boys	Girls	Both sexes	Boys	Girls
Oromiya	66.9	82.6	51.0	19.1	25.5	12.4
Benishangul-Gumuz	98.4	121.2	74.5	1.5	26.8	12.0
Ethiopian average	64.4	74.6	53.8	19.3	24.0	14.3

Source: Ministry of Education (Education Statistics Annual Abstract 2002/03)

Education in An-Nil al-Azraq State is ranked the lowest in the country. There are 184 primary schools in the State catered for by a total of 2,108 teachers. Enrolment rate in primary education in the state is 33.9% and the proportion of children starting grade one and completing grade five is 88.8%. The ratio of girls to boys in primary schools is 0.96 (or 96 girls per 100 boys), which reflects gender equality at the primary education level. The literacy rate of 15+ year olds is 36.7% and the ratio of literate females to males of 15-24 year old is 1.07 (or 107 girls per 100 boys) (Sudan Transition and Recovery Database, 2003).

TABLE 31. EDUCATION FACILITIES IN AN-NIL AL-AZRAQ (BLUE NILE) STATE IN 2000/2001

Level	**Institution**	**Pupils**			**Teachers**
		Girls	**Boys**	**Total**	
Preschool	82	1,899	1,640	3, 539	82
Primary	184	19,576	27,994	47,570	2,108
Secondary	19	1,544	1,915	3,459	235
Technical	5	310	484	794	24
Total	290	23,329	32,033	55,362	2,449

Source: CBS Yearbook, 2000

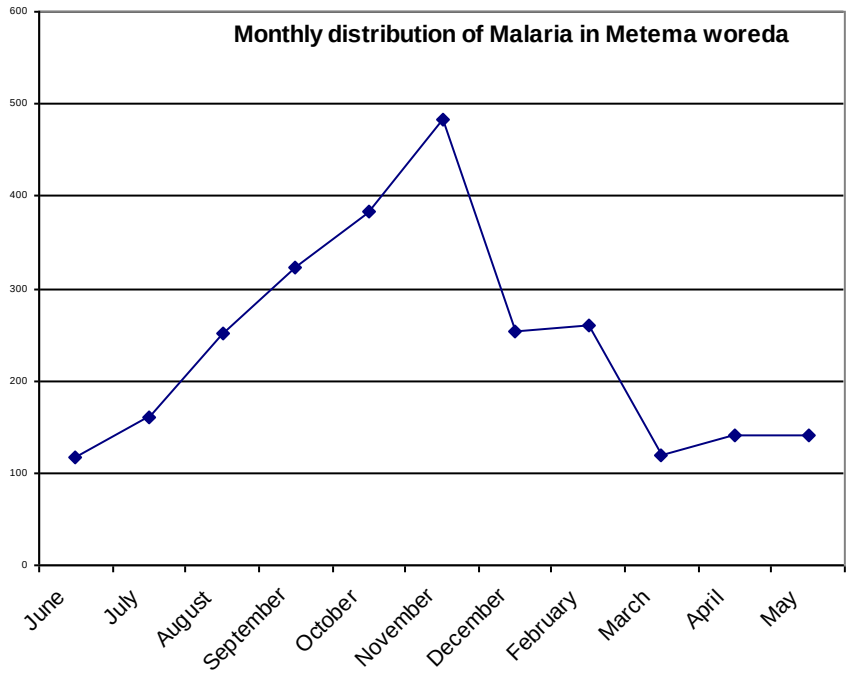
4.4.4 Health

4.4.4.1 Option C

Health is an important social indicator that has enormous human development implications. The Amhara Region is attempting to develop primary healthcare services, paying particular attention to the prevention of communicable diseases such as malaria and other vector borne diseases. However, many people remain underserved by existing health institutions, and there is a lack of trained healthcare personnel. To date, there are 15 hospitals, 78 health centres and 517 clinics. Primary healthcare coverage is 47%.

The ten most prevalent diseases in North Gonder area are malaria, acute respiratory infections, skin infections, intestinal parasites, rheumatism, sexually transmitted diseases (HIV/AIDs), eye disorders, diarrhoea, gastritis and anaemia.

Malaria is one of the major health problems along the project road. According to information obtained from various health services within the Project affected area, *Plasmodium vivax* and *P.falciparium* are the commonly occurring malarial parasites in the project area. Data from the Metema health centre revealed that malaria cases are common throughout the year (see figure below) although it tends to peak during the months of October and November.



Source: Azezo-Metema Road ESIA Draft Final Report (September 2004)

In Sudan, the areas under consideration suffer from a similar lack of health delivery. As with the Project affected areas in Ethiopia, there is high incidence of malaria and bilharzias, as well as with a high rate of maternity mortality.

TABLE 32. HEALTH INDICATORS, AL-QADARIF STATE

Health Indicators	Numbers
Crude Birth Rate (per 1000)	38.8
Crude Mortality Rate (per 1000)	20.4
Infant Mortality Rate (less than 5 years, per 1000)	16.36
Child Mortality Rate (less than 1 year, per 1000)	67
Child Mortality Rate (less that 5 years, per 1000)	117
Female Mortality Rate of Pregnancy and Birth (per 1000)	644
Life Expectancy (Male)	50.5
Life expectancy (Female)	52.6

Source: Administration of Statistics, Al-Qadarif State.

TABLE 33. MAIN HEALTH INSTITUTIONS IN AL-QADARIF STATE

Health Services	Numbers
No. of Hospitals	13
No. of Health Centres	72
No. of Health Units	97
No. of Doctors	58
No. of Health Supporting Staff	129
Environmental Health Workers	715

Source: UNICEF (2004)

4.4.4.2 Option B1/B2

The health services for both Ethiopian Regions are very low. Infant mortality for the country is 97 per 1000 children and the under five-mortality rate is 166 per 1000 children. The average life expectancy is 53.4 for males and 55.4 for females, which is among the lowest in Sub-Sahara Africa.

The following table shows infant mortality rates and life expectancy for the affected regions and the country.

TABLE 34. INFANT MORTALITY RATE AND LIFE EXPECTANCY AT BIRTH IN AMHARA AND BENISHANGUL-GUMUZ REGIONS

Regions	Infant Mortality Rate (IMR) in 2000	Under 5 Mortality in 2000	Life Expectancy at birth (years)	
			Male in (2000-2005)	Female in (2000-2005)
Amhara	112	183	53.4	56.0
Benishangul-Gumuz	98	198	50.1	51.1
Ethiopia	97	166	53.4	55.4

Source: The National Office of Population, 2003

TABLE 35. HEALTH INSTITUTIONS IN THE AMHARA AND BENISHANGUL-GUMUZ REGIONS

Region	Hospital	Health Centre	Clinic	Health Post
Amhara	30	78	516	384
Benishangul-Gumuz	2	7	66	44

Source: The National Office of Population, 2003

In An-Nil al-Azraq State, health service delivery is extremely poor. The area suffers from a high incidence of malaria and bilharzia, and maternity mortality is particularly high (Gaafar, 1994).

TABLE 36. MAIN HEALTH INSTITUTIONS, AN-NIL AL-AZRAQ (BLUE NILE) STATE

Health Service	Blue Nile State
No. of Hospitals	7
No. of Health Centres	24
No. of Health Units	40
No. of Doctors	41
No. of Health Supporting Staff	388
Environmental Health Workers	68

Source: UNICEF (2004)

The above statistics reveal the poor level of health services in the areas under consideration. This is reflected in the high infant mortality rate (25.9% in Blue Nile) and low access to adequate sanitation (62.7% in Blue Nile) and poor access to safe drinking water (38.3% in Blue Nile) according to UNICEF 2004.

In the Eastern Roseires Reservoir area specifically, there is neither a hospital nor a health centre. The only health service units available are 7 dispensaries (composed of 19 rooms), and 19 dressing stations (composed of 38 rooms). Most of these facilities are constructed from mud or straw. (Gaafar,1994).

4.4.4.3 Option A

The ratios of both health professionals and health institutions to the population in Oromiya Region are far below those recommended by the World Health Organization (WHO). The coverage of health services is estimated at 52.2 percent and is extremely low even by the standards of Sub-Saharan Africa. The Oromiya region has 27 hospitals, 86 clinics and 972 health posts.

A large proportion of the population has neither access to safe water nor sanitation facilities, and as the result, is severely afflicted by water borne diseases. Water supply service coverage of the region is estimated at 34.2 percent. Infant mortality in the region is estimated to be 166.2 per thousand of live birth (OHAPCO Strategic Plan to Fight HIV/AIDS, 2002). The major causes of mortality are malaria, respiratory infections, HIV/AIDS, skin infections diarrhoea diseases and intestinal parasitic infections. The prevalence of such diseases is due mainly to poverty and economic deprivation.

The provision of primary health services in Benishangul-Gumuz is one of the main social development goals of the Region. In 1997, health service coverage was 41%; by 2003 it had risen to 54%. The Region now has 2 hospitals, 7 health centres, 66 government clinics, 44 health posts, 3 NGO clinics and 4 private clinics. The major diseases in the Region are malaria, water-born-, respiratory- and skin diseases, and malnutrition (Facts about Benishangul-Gumuz National Regional State, 2003).

TABLE 37. INFANT MORTALITY RATE AND LIFE EXPECTANCY AT BIRTH IN THE TWO PROJECT AFFECTED REGIONS

Regions	Infant Mortality Rate 2000	Under 5 Mortality Rate 2000	Life Expectancy at Birth (years)	
			Male (2000-2005)	Female (2000-2005)
Oromiya	116	194	53.0	55.5
Benishangul-Gumuz	98	198	50.1	51.1
Ethiopia	97	166	53.4	55.4

Source: The National Office of Population (2003)

There are nine hospitals in the An-Nil al-Azraq (Blue Nile) State. One hospital has specialists, one is a specialised hospital; there are 14 health centres, 40 dispensaries (9 closed), 76 dressing stations (31 closed), 46 public health clinics (22 closed) in addition to one blood bank and two x-ray units (Sudan Transition and Recovery Database, 2003).

The infant mortality rate per 1,000 live births in the state is 101 compared to 66 for the rest of Sudan. The nutrition status of children and women is poor. The most common diseases identified are malaria, bilharzias, tuberculosis, diarrhoea, acute respiratory infection (ARI) and malnutrition.

In 2003 there were very few cases of AIDS reported in the State. However, it is feared that the high population concentration in the IDP camps and their proximity to the Ethiopian border may advance the spread of HIV/AIDS into major towns (ibid, 2003).

4.4.5 Cultural Heritage

The assessment of cultural heritage is based mainly on literature review, objects reported to the National Corporation for Antiquities and Museums, National Museum objects, a short visit to Gedaref, Doka and Roseires-Damazin in Sudan and informants from both areas, and brief visits in Ethiopia. The magnitude of the routes, lack of access during the wet season and timeframe for completion of the study did not allow a detailed survey of the three transmission line routes.

There are many churches and burial sites in the highlands of the study area within Ethiopia. Such cultural/religious sites are not common in the lowlands. The cultural/religious centres serve as sites for the conservation of biodiversity. There are two outstanding examples of conservation which were identified during field work for routes B and C, a Muslim Burial ground and an Orthodox Christian Churchyard. They are described below.

The Muslim burial ground known locally as Abahibre was observed in Adeza area, 36 km from Azezo to Metema at about 12º33’17.0’’N, 37º07’55.4’’E, 1960 m altitude. The community through religious institutions protects it. Members of the local community are not allowed to fell trees and

are not even allowed to collect dead wood. The tree species that was not observed in the general area, but observed in the burial ground site is Olea europaea subsp. cuspidata. Other species, not commonly seen to reach to such large sizes in the area include: *Croton macrostchyus, Euphorbia candelabrum*, and *Ficus vasta*. The shrub and succulent species observed on the site include: *Maytenus serrata* (endemic), *Calpurnia aurea* and *Aloe trigonantha (endemic).*

The Orthodox Christian Church observed was St Rufael Church located 7 km NE of the main road from Azezo to Metema, at about 12º32'56.8''N, 37º22'29.1''E, 2300 m altitude. It is well protected. Here also, members of the local community are not allowed to fell trees and collect wood. The tree species that were not observed in the general area, but observed within the church compound include: large numbers of Weira (*Olea europaea* subsp. *cuspidata*), Bisana (*Croton macrostachyus*), Geteme (*Schefflera abyssinica*), Tid (*Juniperus procera*), *Pittosporum viridiflorum* and Sesa (*Albizia gummifera*). Shrubby species not commonly seen in the area, but occurring in the churchyard include: Misirch (*Clerodendrum myricoides*), Lenquata (*Clerodendrum myricoides*), Tembelel (*Jasminum abyssinicum*); Atat (*Maytenus serrata* (endemic) and *M. arbutifolia*).

Within Sudan, Option C route passes through an area in the eastern extension of the so called Butana region (the area between the Blue Nile and Atbara River). The geography of the area reinforces the prevalent view that the Savannah is devoid of cultural development. This has been supported by the absence of surface indications. The latter is due to the heavy continuous rain falls and mechanized agriculture. The area however, is famous as the home land of the Meroites who established and ruled the Meroitic Kingdom (350BC-350CE), where their great temples are still visible today, standing up to the roof level, reflecting the grandiose, glory and great achievements of its people. Its connection with Ethiopian Axum Kingdom (1st -8th centuries CE) is historically attested.

The caravan trails of Adoulis (coastal city) were the trading routes to the Middle Nile and Meroe. The question of the free passage to the Red Sea ports could have been one of the causes of dispute between Axum and Meroe which ended in the victory of Axum in the 4th century CE. Documentary evidence refers to Axum's oppressive treatment of Meroe which was a major factor in the decadence of this one powerful kingdom. Evidence of trade contacts have been revealed in many of the Axumite sites. The area between the two countries is expected to uncover evidence for the extent of the Axumite intervention in the Meroites domain and whether they occupied parts of it as claimed by Eizana in his famous inscription.

In the late 80s of the 20th century more work was conducted which revealed the existence of the so called Atbai culture (5000 BC) with its remains found extending from north of the Atbara River to parts of the Blue Nile area and extending eastward into the Ethiopian plateau (Marks & Abbas 1986).

The work conducted at Dinder in 1997 has revealed 14 sites close to it and as far away to the south east as the Sudan Ethiopia border. Pottery has also been found dated to late Meroitic and post Meroitic times (Ahmed &Ahmed 2004).

The visit during this study along the route from Gadaref to Doka revealed a few raised areas which might indicate the presence of archaeological sites. The National Museum records report two artefacts collected from the area: a sword dated to the Mahdiya period which was brought by a citizen from Gedaref; and, a gubba or tomb of a Sheikh at Gedaref. There is a single record of a National Museum Registered Object – that of a Neolithic flint hand axe (No. 3969).

Both Options A and B in Sudan pass through an area well known as part of the domain of the first Islamic kingdom in the Sudan - the Funj kingdom (CE 1504-1821). The post medieval studies in the Sudan are meager in general and very rare as far as the southern areas are concerned. In recent years an increasing number of sites along the Blue and White Niles have been investigated and reported (Edwards 1991; Eisa 1999; Kleppe1986). Pottery collected from a number of sites close to Roseires has been described and dated by Addison to the 6th century CE(Chataway;1930).

Recent work has been carried early this year by the Blue Nile University, based in Damazin, whereby evidence of different periods was collected. The mission reported five sites on the eastern bank of the Blue Nile near Roseires and another five sites on the western bank of the River. Thirty

three objects were collected from test pits, surface scatter and objects handed by local people found during earth moving for building purposes. The objects were given museum numbers from 3153-315696, some were dated back to the Meroitic period 350BC-CE350. Others dated to the Funj period. The team also discovered rock drawings at the site of Jebel Agdi (N 11^0 48' 597", E 34^0 04' 177" which goes back to the Neolithic period (New Stone Age) thus giving the area more depth in prehistoric time.

The area is promising to answer many thorny questions on the Funj origin, whether they are Shulluk, Nuba, Ethiopians or of Arabic origin. Despite the limitation of the investigations so far, they provide further insight into the question of the southern limits of the extension of the Meroitic culture. A number of sites from the Meroitic period have long been known to exist along the Blue Nile. These recent discoveries provide further incite into the question of the relationship between the Nile Valley and the Ethiopian Highlands in ancient times when trade was carried along the route running southeastwards across the Butana.

The only information gathered during a quick visit to Roseires came from the Umda (local chief) Abdel-Aziz al-Amin who mentioned the existence of remains of pottery and bones in his homeland Kadalo, where people lived on top of mountains. Nothing is reported to the local police station. The National Musuem reports the following registered objects in the area:

- Shards of various types from small hill left of the road, about 1/2 mile north of Roseires.
- Shell beads, museum no. 2785, Meroitic.
- Pot shards, museum no.2786.
- Meroitic scarab, museum no. 3643 from the dam area.

Since it was not feasible or practicable as part of this study to undertake detailed site surveys for hundreds of kilometres covering the three alternative routes, it is important that adequate safeguards are in place to ensure appropriate procedures are followed should any items of cultural heritage be uncovered during construction activities associated with the Project. In Sudan, the National Corporation for Antiquities and Museums is the authority that issues licences, conducts and/or participates in all archaeological work carried out in the Sudan. The Authority for Research and Conservation of Cultural Heritage has a similar role to play in Ethiopia.

4.5 Economic Activities

4.5.1 Livelihoods and Economic Practices

4.5.1.1 Option C

Agriculture is the dominant economic sector of the Amhara Region. It accounts for 63.1% of the regional GDP and 89% of the population derives its livelihood from agriculture and allied activities. It is the major source of food, raw materials for local industries, and export earnings.

Crop production and animal husbandry are the major agricultural activities undertaken in the region. Crops such as cereals, pulses, oil seeds, fibres, and root crops are grown in different parts of the Region. Major crops include maize, sorghum, potato, bean, wheat, and barley in the highlands, and teff, cotton and sesame in the lowlands. Sesame and cotton are the major cash crops for the farmers. In addition, outside investors have become involved in the production of incense and gum Arabic.

Small-scale subsistence cultivation is the dominant agricultural practice, and ancient methods of land preparation and harvesting continued to be applied. Absence of relevant agricultural technologies, combined with a low level of extension services, contribute toward low productivity and production levels. Fundamental needs such as food, fuels, building materials, fertilizers, raw materials (e.g. bamboos), and various types of grass for traditional crafts and occupations are all forms of the biomass, most of which are collected freely from the immediate environment.

Cattle, goats and equines are the most important source of traction power, meat, milk, skin and hides. Given the limited availability of communal grazing lands in the Region, however, there is a

severe shortage of animal feed. This has become a contributing factor for low productivity and production levels in the livestock sector.

The major economic activity for urban residents is trading. Although there is some similarity in economic activity between the Woredas, there are also differences resulting from the extreme ecological variations in the area. The proximity of many of the towns to Sudan means that trading opportunities between the two countries may be exploited. The Metema-Gallabat border serves as the main passage for the importation of fuel from the Sudan and for the exportation of cash crops (e.g. cotton, sesame and gum) to Sudan from the Amhara Region.

TABLE 38. MAJOR CROPS, THEIR PRODUCTION RATES AND CURRENT PRICES (USING LOCAL SEED WITHOUT FERTILIZER INPUT)

Type of crop grown	Production in quintals/hectares	Current cost in US$/q
Teff	5	32
Maize	20	13.8
Sorghum	15	9.3
Cotton	10	34.8
Sesame	4	63.5

Source: Metema Woreda Information office (2003)

TABLE 39. ARABLE LAND IN PROJECT AFFECTED AREA BY TYPE AND WOREDA

Type	Bahir Dar		Libo Kemkem		Dera		Fogera		Maksengit	
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Arable and Farm Land	38374	21	55119	51	73,559	46	51,896	44.2	51,466	47.5
Pasture Land	16640	9	8686	8.3	10152	6	26,888	22.9	29,276	27.02
Forest and Bush Land	13,504	8	6484	5.9	1,715	1	2113	1.8	4887	4.51
Occupied by Human Settlement	15,631	9	11889	10.9	9,113	6	7045	6	8451	7.8
Irrigation		0				0	23482	20		
Covered with Water, rivers and Valleys	64,777	36	19453	17.98	40,383	25	4344	3.7	2004	1.85
Waste land	29,611	17	6526	6.13	18,281	11	1643	1.4	12,265	11.32
Other (swampy, rural, markets etc)	0	0			5,875	4				
Total	**178,539**	**100**	**108,157**	**100**	**159,078**	**100**	**117,414**	**100**	**108,351**	**100**

Source: Woreda Agricultural Development and Information Bureau 2006.

TABLE 40. ARABLE LAND IN PROJECT AFFECTED AREA BY TYPE AND WOREDA

Type	Gonder Zurga		Dembia		Chilga		Metema	
	Ha	%	Ha	%	Ha	%	Ha	%
Arable Land (Cultivable)	6000		78,909	52	**	--	32,652	7.4
Farm Land	49,978		17,866	12	85,535	21.7	71,288	16.2
Pasture Land	29,276		8931	6	7,546	1.9	18,200	4.13
Forest and Bush Land	4886		5955	4	88,005	22.3	312,300	71
Occupied by Human Settlement	8462				2838	0.72	3875	0.88
Irrigation	--		37,221	25	120	0.03	--	0
Others	17,805		--	--	210,437	53.3	1800	0.42
Total	**116,407**	**100**	**148,882**	**100**	**394,500**	**100**	**440,115**	**100**

Source: Woreda Agricultural Development and Information Bureau 2003, 2005.
** In Chilga the arable land is included in "Others"

The State of Al-Qadarif is dependent mainly on agriculture, some 10 million feddans of which is arable land. During 1998-2002, agriculture contributed an average of 91% of the GDP of the State, explaining a weak contribution of the services sector (5.4% of GDP) and the industrial sector (3.6%).

There are two major agricultural systems in the State, the most important of which is irrigated or rainfed mechanized agriculture. Mechanized agriculture in Sudan was introduced by the British colonial government in the 1940s. Al-Qadarif State is considered to have pioneered this type of agriculture in Sudan, and has subsequently become the main commercial producer of sorghum and sesame. Today, mechanized agriculture is directed by the government of the State via the Mechanized Agriculture Agency.

TABLE 41. CONTRIBUTION OF DIFFERENT SECTORS IN AGRICULTURAL GDP

Sector	1998 Percentage (%)	1999 Percentage (%)	2000 Percentage (%)	2001 Percentage (%)	2002 Percentage (%)
Rain fed Agriculture	31.4	26.3	27.8	11.8	11.5
Irrigated Agriculture	2.4	3.2	2.9	4.0	2.2
Livestock Raising	66.0	70.4	69.2	84.1	86.2
Forestry	0.2	0.1	0.1	0.1	0.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Administration of Statistics, Al-Qadarif State (2003)

Mechanized agriculture has been expanding horizontally at the expense of forestry and natural rangelands. It has also become the main cause of land degradation in the State. Lands are subjected to continuous mono-cropping which has led to loss in soil fertility. Agricultural productivity has dropped to the extent that in some parts of the State, the contribution of agriculture to the regional GDP is no longer comparable with that of livestock.

The second agricultural system practiced in the State is traditional rainfed farming. It is characterized by small-scale farm allotments (bildat), which are cultivated with the use of rudimentary technologies and family labour. Staple food crops like sorghum, millet and sesame are grown on these small farms, which tend to be located close to villages and settlements. Cultivation is often combined with sedentary livestock husbandry. Farming in this instance is mainly subsistence-based.

The majority of farmers in the State depend on the informal credit system known locally as Sheil or Kasir.

Northern Gadaref Locality is predominantly pastoral and the local tribes are traditionally livestock owners. They raise camels, cattle, sheep, and goats. The pastoral tribes follow specified transhumance routes in their seasonal movements which are dictated by the need for food and water. During the dry season, they stay in their grazing areas in the southern parts of Al-Qadarif State along the Rahad River; in the rainy season they move northwards to the Butana and Atbara Rivers. However, this traditional pattern of movement has been disrupted and in some cases blocked by mechanized rain-fed farming and irrigated schemes such as the Khashm El Girba and Rahad Schemes. Hence, nomads are forced to follow narrow routes and move long distances to avoid agricultural areas or, in some cases, they prefer to stay in the southern parts of the state in Gallabat locality despite the hazards of animal diseases.

The main herding groups in the Al-Qadarif State are the Shukriya, Lehawin, Beni Amer and Kenana. The increasing numbers of livestock beyond the carrying capacity of the rangelands in recent years has become a cause for concern, and is contributing to the ecological problems of an already fragile environment.

In Ethiopia, communities living in villages along the Option C (Preferred route) alignment derive their income from a wide variety of sources. According to the Metema Woreda Information Bureau, the average income obtained from the sale of livestock and its products by household is estimated to be Birr 1140 annually (US$133), (See Table 42).

The relative importance of different sources of income is also shown in Table 42. The importance of crop farming is clear. It represents the most important income source in the great majority of villages. Sesame and gum arabic are also of vital importance to the economy in the lowland areas. Non-agricultural income sources (e.g. daily employment on commercial farms) do also exist, but are limited.

TABLE 42. HOUSEHOLD'S ANNUAL INCOME AND EXPENDITURE

Average Land Holding 4 Hectares (Cultivable land 3.7 Hectares)			
Income Sources	**Value**	**Expenditure**	**Value**
Crop production (kg)	2700	Food	2669 (45%)
Crop Value in Birr	4725 (80%)	Social affairs	1200 (20%)
Income from livestock (Birr)	1140 (19%)	Health	247 (4%)
Other agricultural and non agricultural activities	40 (1%)	Education	10 (0.2 %)
		Household utensils	42 (0.7%)
		Seeds and farm inputs	906 (15%)
		Other	494 (9%)
		Saving	337 (6%)
Total	**5905**		**5905**

Source: Woreda Information Bureau (2003)

4.5.1.2 Option B1/B2

In Amhara and Benishangul-Gumuz Regions agriculture and in particular crop farming is the major source of income and livelihood activity for over 90% of the population.

Agriculture, and crop farming in particular, is characterized by small-scale household farming, and it is practiced with traditional methods of cultivation and subsistence farming. Agriculture is mainly rainfed and, as such, is dependent on the vagaries of nature. The irrigation potential is high in both Amahra and Benishangul-Gumuz, but water has not yet been harnessed. Consequently, crop yield rates are low.

In Amhara, agriculture contributes over 60% to the regional GDP. Approximately one-fifth of the total land area in the region is used for agriculture. The cultivated landholding size is less than one hectare per household. Productivity is low at about 10 quintals per hectare.

The crops that grow in the region are mainly cereal, pulse, and oil crops. Table 42 indicates the three Project affected zones in Amhara that are used for cultivation and the amount of production for each type crop.

TABLE 43. CULTIVATED AREA AND PRODUCTION IN THREE ZONES OF AMHARA REGION

Crop type	**West Gojam**		**East Gojam**		**Awi**	
	Area in ha	**Production**	**Area in ha**	**Production**	**Area in ha**	**Production**
Cereal	113,791	2,914,374	66,654	1,190,472	8,875	57,650
Pulse	46,654	485,898	70,327	738,756	41,260	1,058,296
Oil crop	42,896	214,292	20,450	97,847	24,182	78,076

Source: Amhara Region Socio Economic Information, 2002

In Benishangul-Gumuz less than 3% of the total area is under cultivation (Regional Government of Oromiya (2004) Statistical Abstract, 4th Edition.) Farming practices and techniques used are traditional using hand tools, such as hoe and slasher. The indigenous population (Berta, Gumuz, Mao and Komo) do not use oxen for ploughing. Shifting cultivation is practiced by Gumuz and Berta people in the region. About 59% of the region is covered by different kinds of forests, including lowland bamboo forest.

Sorghum, millet and maize are the major crops that grow in Benishangul-Gumuz Region. Crop production and productivity is very limited due to the use of rudimentary labour-intensive farm tools, prevalence of crop diseases, pests and weeds, and the prevalence of human diseases such as malaria. Poor rural infrastructure facilities such as markets and roads, and limited availability of small-scale credit facilities have also contributed to low agricultural production in the region.

In Benishangul, livestock keeping is constrained mainly by the prevalence of cattle diseases such as trypanosomiasis. However, the Benishangul-Gumuz Region has forest potential such as bamboo, incense and other indigenous trees. The mining potential includes marble and traditional gold mining.

In the An-Nil al-Azraq (Blue Nile) State, the localities to be affected by the proposed transmission line include: Roseiris, Damazin and Kurmuk. In all these localities, agriculture is the dominant

activity. Agriculture is practiced in gerouf (river bank cultivation), jubraka (house farm), bildat (smallholder cultivation) as well as partially mechanized rain-fed farming in large schemes. The dominant crops grown are sorghum, millet and sesame. The study (Gaafar, 1994) found that farming contributes to 49% of the household income consisting of 43% from crops and 6% from livestock. The remaining 51% come from a wide range of off farm activities which include commerce, handicraft, wood cutting, charcoal burning and wage labour. Various types of livestock are also kept by the inhabitants under sedentary, semi-nomadic and nomadic conditions. Recent estimates showed that there are about 2,899,000 cattle, 2,641,000 sheep, 1,484,000 goats and 160,000 camels in the An-Nil al-Azraq (Blue Nile) State. The various activities affected the ecological conditions leading to deterioration of grazing resources and removal of natural forest. However, the civil war in Southern Blue Nile created good conditions for natural regeneration of forests.

TABLE 44. OWNERS AND AVERAGE AREA OF AGRICULTURAL HOLDINGS IN EASTERN ROSERIES RESERVOIR AREA (1994)

	No. of Holdings	No. of Owners	Average Area (Feddans)	% of Owners to Total Holdings in the Area
Orchards	789	691	2.2-6.5	5.9
Rainland	12836	11265	8.9-27.4	95.8
Gerouf	8438	7848	1.6-3.6	66.7

Source: Gaafar, 1994

Of those who do not participate in farming, almost 36% participate in some form of artisanship: 14% in wood cutting and charcoal burning, 11% in fishing and 39% in a variety of other activities including wage employment. However, it is important to emphasize that agriculture remains the most important activity that provides employment to the inhabitants and represents the basis of their survival (Gaafar, 1994). A 1994 study of a sample of households living in the areas to be affected by Roseires Dam Heightening showed the following sources of income.

TABLE 45. MAJOR SOURCES OF INCOME

Activity	Percentage (%) of Household Income
1. Farming only	29.3
2. Farming + Artisanship	20.0
3. Farming + Commerce	12.1
4. Farming + Fishing	5.1
5. Farming + Forestry	14.0
6. Farming + Wage labour	5.7
7. Farming + others	4.8
Total	100

Source: Gaafar, 1994.

4.5.1.3 Option A

Two zones in Oromiya Region fall within the Project affected area, namely East and West Wellega. East Wellega spans a total area of 25,234.4 km sq of which 45.5% accounts for arable land, 15.7% for pastureland; forest and bush covers 11.7%, while degraded and 'other' share some 27.1% of the zonal area. The zone has 17 districts and Nekemte is its administrative capital. West Wellega spans an area of 23,980 km sq, of which 31% is under cultivation, 5.4% under pasture, and 6.1% under forest lands. The remaining land is degraded or urbanized. The zone has 17 districts and 44 urban centres, and Ghimbi is the administrative capital.

In both zones, teff, wheat, barley, maize, sorghum, millet, horse beans, peas, haricot beans, sesame, lentils, and root crops are important crops. Coffee is of particular importance to this Region, where it is believed to have originated (Coffee Arabica). In addition to agricultural production, livelihoods are sustained through the production of cattle, goats, sheep, and poultry and through bee-keeping.

Benishangul-Gumuz Region is one of the least developed Regional states in Ethiopia. Approximately 59% of the Region is still covered with indigenous forests, woodland and bamboo thickets and it enjoys an annual rainfall of 500-1800 mm (May-October). Like Ormoiya, it is a topographically varied, 75% of which is lowland, 24% midland and 1% highland. The Region is

known for its endemic lowland bamboo forests (*Oxytenantra abyssinica*), incense trees (*Boswellia papyrifera*) and caster oil (locally referred to as noug), all of which have important investment potential. Major crops produced are millet, sorghum, sesame, cotton, soya beans, coffee and mangos. Traditional gold mining and non-sustainable forest dependent activities such as charcoal and firewood production provide other means of livelihood.

Both regions are rich in metallic and non-metallic mineral resources that are conducive for medium and large scale industrial development. Several mineral deposits, such as marble, iron, coal, gold, platinum, cobalt, chromium, copper, lead, titanium, uranium, gypsum, silica are widely available. Marble, limestone, gold, platinum, soda ash and mineral water are widely exploited (Bureau of Planning & Economic Development, Council of the Regional State of Oromiya, Ethiopia, 2000).

An-Nil al-Azraq (Blue Nile) State the main livelihood activities are agriculture and livestock. The traditional peasant farmers usually grow sorghum, sesame, groundnuts, vegetables and fruits while nomadic tribes keep animals such as cattle, goats, sheep and donkeys. In the past, An-Nil al-Azraq hosted mechanized farms that exported grain to the neighbouring areas. Today, the unstable security situation, limited access to land, lack of production inputs and poor access to safe drinking water hampers food security in the state. While the residents, returnees and old internally displaced people (IDPs) are able to produce their own grain, new IDPs have no access to farmland and have limited labour opportunities to supplement their basic needs.

4.5.2 Rural Electrification

According to the publication 'Ethiopia: Sustainable Development and Poverty Reduction (2002)", Ethiopia has one of the lowest levels of electricity generation per capita in the world, which stood at 28KWh. Only 13% of the population has access to electricity. Electricity is thus a major constraint towards establishment of agro-processing industries, commercial enterprises and irrigation facilities in the rural areas. Besides, delivery of health and education services remains inefficient in the absence of electricity.

The publication suggests that electricity supply to rural towns would replace/reduce the consumption of woody biomass and petroleum products used for cooking, lighting, and motive power. Further, there is a particular demand for electricity in the agricultural sector (irrigation pumps, poultry, animal husbandry, preservation of products), in the commercial sector (shops, bars, and restaurants), in small and medium industries (flour mills, oil mills, rural water supply installations, tanneries, and coffee processing plants), in the residential sector (lighting, heating, and cooking), in education (kindergarten, elementary schools, junior secondary schools, secondary schools and technical colleges), and in the health sector (pharmacies, clinics, health centres and hospitals).

Provision of electricity would result in an increase in commercial activities while boosting the production of small and medium industries including coffee and leather processing industries. In brief, it would facilitate all rounded economic growth in the rural areas and create employment opportunities for the poor, including women, thereby increasing income levels and reducing poverty (Ethiopia: Sustainable Development and Poverty Reduction Programme 2002).

The only sizeable area of Sudan that had access to electric power in 1991 was the central region along the Blue Nile from Khartoum south to Ed Damazin. At this time, the central region accounted for approximately 87% of Sudan's total electricity consumption. The area was served by the country's only major interconnected generating and distributing system, the Blue Nile Grid. This system provided power to both the towns and the irrigation projects in the area, including the Gezira Scheme. Another small, local, interconnected system furnished power in the eastern part of the country that included Al-Qadarif and three other States. The remaining customers were located in fewer than twenty widely scattered towns having local diesel-powered generating facilities. About fifty other urban centres in outlying regions, each having populations of more than 5,000, still did not have a public electricity supply in 1982, the latest year for which statistical information was available. Rural electrification was found only in some of the villages associated with the main irrigation projects (http://www.photius.com/countries/sudan/economy/sudan.economy.electric.power.html).

5 Environmental Impacts

5.1 Methodology

5.1.1 Scoping

Scoping is the process of identifying and "narrowing down" the potential environmental impacts associated with the development. The scoping process ensures that the ESIA focuses on pertinent issues. The level of an impact assessment will depend on the nature and scale of the development proposal and its complexity, the sensitivity of the environment, and issues identified during the scoping process.

The 1995 feasibility study update (IVO International 1995) provided the initial scoping for this Project and was the basis for the World Bank deciding to classify the Project as a Category B Project requiring an ESIA and separate RAP.

Meetings and discussions with various environmental, legal and social staff from Amhara Region EPA (in Bahir Dar) in Ethiopia helped with scoping of this study as did meetings with village committees and regional administrative staff in the Project area in Sudan (Appendix 3 presents a list of consultation).

5.1.2 Impact Analysis

The identification of the positive and negative impacts of the Project, their level of severity (low, medium, or high) whether they are long term or short term, direct or indirect, avoidable or unavoidable, reversible or irreversible and their classification into pre-construction, construction and operation has been based on the following.

1. The socio-economic and environmental studies undertaken in the feasibility update in 1995 (IVO International Ltd, 1995).
2. The engineering feasibility update undertaken this year (Hifab Oy Consultants in Association with Fingrid Oyj and SOGREAH Consultants, 2005).
3. World Bank Environmental Assessment Sourcebook and updates (World Bank 1994).
4. World Bank Operational Policies/Directives, namely: OP/BP 4.01 Environmental Assessment, OP/BP 4.04 Natural Habitats, OP 4.09 Pest Management, OP/BP 4.11 Physical Cultural Resources, OP/BP 4.10 Indigenous Peoples, OP/BP 4.12 Involuntary Resettlement, (see Section 2.5).
5. International Agreements ratified by the Governments of Ethiopia and Sudan (see Section 2.6).
6. The EIA guidelines of the National and Regional Environment Protection Authorities of the Governments of Ethiopia and Sudan (including sectoral guidelines) and of NEC and EEPCO where available (see Sections 2.1 and 2.2).
7. Consultation with: people who are affected by the Project; officials from relevant ministries and government agencies (national, regional and local); village committees/elders; women as local users of natural resources; and, NGOs/CBOs (see Appendix 3).

5.1.3 Public Consultation

5.1.3.1 Objectives of Public Consultation and Information Dissemination Programme

In the context of resettlement, public participation includes both the information exchange (dissemination and consultation), and collaborative forms of decision-making and participation. Dissemination refers to transfer of information from Project authorities to the affected population. Consultation, on the other hand, generally refers to joint discussion between Project authorities and

the affected population serving as a conduit for transfer of information and sharing of ideas. Public participation is an ongoing process throughout resettlement planning and implementation, not an event. The level of information which is disseminated or the issues on which consultation takes place vary with the progress in the Project process and resettlement activities.

Specific objectives of the public information campaign and public consultation are as follows:

- To share fully the information about the proposed Project, its components and its activities, with the PAPs.
- To obtain information about the needs and priorities of the PAPs, as well as information about their reactions to proposed policies and activities.
- To inform PAPs about various options for relocation and rehabilitation.
- To obtain the cooperation and participation of PAPs and related communities in activities required to be undertaken for resettlement planning and implementation.
- To ensure transparency in all activities related to land acquisition, resettlement and rehabilitation.
- To establish a clear, easily accessible and effective complaints and grievance procedure.
- To assist PAPs in relocating to replacement houses.

5.1.3.2 Public Participation and Consultation in Resettlement

Project Preparation

During the RAP preparation phase of the Project, information on the Project was provided to different stakeholders as part of the preparation of the inventory of impacts and the Socio-Economic Survey (covering 100% of PAPs for Option C, 28 % on Option B, and on a random basis on Option A). This involved holding meetings with Regional administration officers, representatives of woreda and kebele in Ethiopia, and omda in Sudan. Meetings took place either in groups or on a one-to-one basis. The Project was explained with particular emphasis on the nature of the impacts and the compensation entitlements. Care was taken to keep the information within context and to ensure that people understood the limitations of the impact. This particularly applies to the limited extent of the land acquisition requirement, and that permanent land acquisition is only required for the construction of transmission towers, substations and access roads.

Discussions and consultations about the actual compensation rates to apply will be carried out by the Executing Agencies (EEPCO and NEC) in association with Regional Administrators during Project implementation and a joint agreement reached.

Ongoing community liaison for the Project includes the following:

- Review inventory of PAPs and impacts on the basis of the design and detailed siting of the Project
- Confirm identification of PAPs and compensation entitlements.
- Inform PAPs about the project, activities, effects, compensation and related provisions and timing.
- Confirm PAPs' preferences for how replacement land, houses and crop losses are to be provided or purchased.
- Provide independent financial advice or counselling for PAPs to receive significant cash compensation.
- Complaints and grievance procedure.

Public Participation During the RAP Study

Public consultation took place on a number of levels and at several stages of the RAP process. In so doing, it ensured that there was open and interactive communication between stakeholders, that

minority groups and women were fairly represented, and that there is a framework for effective disclosure to all relevant stakeholders.

Persons and organizations consulted during the ESIA and RAP studies included:

- People who are affected by the Project, both those who are potential beneficiaries and/or losers;
- Officials from relevant ministries and government agencies;
- Officials from regional and local administration: relevant bureaus and departments, municipalities, local administration offices, and/or peasant associations;
- Local elders who are familiar with the social and economic environment. They would also know sites of significance related to religious or cultural traditions;
- Women as local users of natural resources;
- Local NGOs and CBOs.

Public consultation formed an integral part of the process used for gathering data, understanding community and individual preferences, selecting project alternatives, and designing viable and sustainable mitigation and compensation plans. Recommendations for ongoing consultation during final design as well as during Project implementation are included in the EMP (Section 7) and in the recommendations contained in the separate RAP Report.

In addition to the record of consultation outlined in Appendix 3, the Consultant's Legal Specialist has undertaken the following visits during the first month of mobilisation to identify the legislative and regulatory guidelines for environmental and social impact assessment in Ethiopia. A similar process was undertaken by the Consultant's Team in Sudan.

1. Environmental Protection Authority: discussed with Ato Wonwosen Sintayehu, Head, Legal and Policy Department; collected guidelines and conventions.
2. Ethiopian Roads Authority (ERA): discussed with Ato Lulu Berhanu, Executive Assistant to the General Manager and Ato Megersa, an environmental expert in the Planning & Programming Division.
3. Authority for Research and Conservation of Cultural Heritage: discussed with Ato Aweke Wube, Head, Legal Services.
4. World Bank, Addis Ababa: discussed with Ato Yesuf Haji Ali, Operation Officer, Energy Project, Africa Region
5. Gilgel–Gibe Hydropower Project Office II: discussed with Ato Semaneh Bekele, Project Coordinator
6. Ministry of Foreign Affairs: discussed with Ato Ibrahim, Director, Legal Affairs Directorate

The following is a List of Interested and Affected Parties (IAPs), including Non-government organisations (NGOs) with respect to the bio-physical resources which were consulted during the preparation of the ESIA.

- Wildlife and Natural History Society of Ethiopia (WNHS)
- Manager, EPA, Benishangul Gumuz Regional State, Ethiopia
- Amhara Regional Office for Agriculture and Rural Development Department
- Professor Zerihun Woldu, Terrestrial Ecology, Addis Ababa University
- Ministry of Science and Technology, Republic of Sudan

ENTRO and EEPCO organised a Workshop in Addis Ababa, Ethiopia from 23-25 November 2005 so that the results of the feasibility update and ESIA/RAP studies could be presented to stakeholders to obtain their comments and involve them in developing an implementation plan to

progress the Project. ENTRO and NEC organised a similar Workshop in Khartoum from 2-4 December 2005. The list of Workshop participants is included in Appendix 5.

5.2 Description of Impacts

This Section deals in detail with a description of the impacts of the Project assuming Option C is implemented. Section 6 provides an analysis and comparison of the alternative routes (Options B1/B2 and A) against the preferred route.

The potential environmental impacts of the installation of the power transmission line from Ethiopia to Sudan were assessed using data collected from field investigations (between August and October, 2005, and February and July 2006), government offices, review of relevant documents and consultation with various stakeholders and Project Affected Persons. The adverse impacts of the Project will be lessened by the fact that the transmission line route will be directed close to existing or planned transmission lines. EEPCO has already committed to the construction of a 230kV line from Gonder to Shehedi near the Sudanese border and this line will be upgraded to accommodate the Ethiopia-Sudan Power System Interconnection Project. Beyond Metema, the proposed new transmission line will follow approximately the alignment of the existing major transport corridor between Ethiopia and Sudan to the city of Gedaref.

Positive Impacts

- **Direct Positive Impacts**

While major attention will focus on loss of income due to temporary disturbance to fields or grazing areas, and on health conditions related to the influx of foreign workers, positive opportunities to PAPs may be presented in the form of temporary employment during the construction phase, as well as through income generated by the sale of food and other consumables to migrant workers.

The most positive impact of the Project could be the provision of electricity to communities within the Project alignment. As detailed in the Recommendation Section of the Report, developing the transmission line in association with an existing or proposed single-circuit alignment (as would be the case with Option C in particular) would ensure tangible benefits to local communities.

- **Indirect Positive Impacts**

In the Recommendations outlined in this report, the Consultant emphasizes that the provision of local electrification either directly from the Project, or as a complementary and indirect benefit of the Project, would be the most significant long-term positive impact of the Project.

Rural electrification lies at the centre of the poverty-reduction programmes in both Sudan and Ethiopia, and would support rural economic development through the provision of power to generate water pumps, grinding mills and local industries.

Significantly, local electrification would have significance with regard to women's work burden; pumped water and electricity would spare them the arduous daily responsibilities of collecting water and fire wood. So too would it have a significant impact on the environment which is widely threatened by deforestation and soil erosion.

Electricity would support overall investment in education and strengthen the ongoing effort of capacity building to overcome critical constraints in the implementation of development programmes. Essential to this effort would be power supply to health facilities for the installation of cold storage facilities for the safe transportation and storage of vaccinations and other vital medications.

Given the detailed socio-economic profiles presented earlier, which indicate that most Project affected communities are severely under-serviced, it is evident that power supply to local communities by this Project would have far-reaching positive development implications.

Negative Impacts

The main potential adverse impacts of the Project would occur mainly during the construction stage in the form of:

- Permanent loss of land under various uses due to land acquisition for establishment of transmission towers;
- Temporary and limited air and noise pollution due to construction activities;
- Minor permanent loss of vegetation due to land acquisition for the reasons mentioned above and for the establishment of right of way (ROW) twenty meters on either side of the centreline of the transmission line;
- Minor permanent loss of commercially important trees due to the establishment of ROW and construction activities;
- Minor permanent loss of biodiversity as a result of loss of flora and loss of habitat for fauna;
- Increased risk of communicable diseases during the construction phase.

Many of these effects will be short term and reversible, stemming from ground disturbance, operation of equipment, and construction of temporary work camps, and construction material processing and storage.

Two universal concerns about transmission line projects are (1) disposal of polychlorinated biphenyls (PCBs) once used in electrical equipment, and (2) possible health impacts of electromagnetic fields (EMF) associated with power transmission lines.

Polychlorinated biphenyls (PCBs)

PCBs used to be widely used as insulators in electrical equipment, including transformers, capacitors, switches, voltage regulators etc. They are of concern because they are powerful toxins, even at low concentrations, and they persist and bio-accumulate in the environment creating adverse health impacts and adverse ecological changes. Intentional PCB production was ended in most countries by 1980 and most transformers and capacitors built after 1980 do not contain PCBs. The major exception to this is transformers and other PCB applications produced since 1980 in the former Soviet Union.

The Basel Convention on Persistent Organic Pollutants lists PCBs as one of 12 target persistent organic pollutants requiring particular attention. This is also reflected in the WB EA Sourcebook update dealing with "Privatisation and Environmental Assessment: Issues and Approaches" (March 1994). This states that the WB considers the use of PCB containing transformers a "red flag".

Refurbishment of any substations for this Project will need to check whether any such old transformers/equipment will be replaced and appropriate safeguards taken. This is not an issue with new transformers, as they will not contain PCBs.

Both NEC and EEPCO are aware of the PCB issue and are implementing programs to address potential problems. The Sudan Higher Council for the Environment and Natural Resources is running a program with NEC on electrical equipment containing PCBs and NEC has agreed with the Council, in accordance with the Basel Convention (Section 2.6), that by the year 2020 NEC will complete removal and disposal of all PCBs and that all new equipment will not contain PCBs. Staff of the Environmental Management Unit of EEPCO have advised the Consultant that EEPCO is currently undertaking an inventory of all equipment to identify the presence of PCBs. Following completion of the inventory, EEPCO will develop a program for the safe removal and disposal of any PCBs found in accordance with the Basel Convention to which it is a signatory (Section 2.6).

Health Effects of Electromagnetic Fields (EMF)

Electric and magnetic fields (EMF) are invisible lines of force that surround any electrical device. Power transmission lines, electrical wiring, and electrical equipment all produce EMF. There are many other sources of EMF as well. Electric fields are produced by voltage and increase in strength as the voltage increases. The electric field strength is measured in units of volts per metre (V/m). Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T). Most electrical equipment has to be turned on, i.e., current must be flowing, for a magnetic field to be produced. Electric fields are often present even when the equipment is switched off, as long as it

remains connected to the source of electric power. In summary, voltage produces an electric field and current produces a magnetic field. The US National Institute of Environmental Health Services and the National Institutes of Health has prepared a comprehensive report on electric and magnetic fields associated with the use of electric power which is available on the World Wide Web at: http://www.niehs.nih.gov/emfrapid.

Electric fields are shielded or weakened by materials that conduct electricity—even materials that conduct poorly, including trees, buildings, and human skin. Magnetic fields, however, pass through most materials and are therefore more difficult to shield. However, both electric fields and magnetic fields decrease rapidly as the distance from the source increases. As a precautionary measure, both NEC and EEPCO have adopted internationally accepted standard ROW width of 40m along their high voltage transmission lines. All habitation and structures are excluded from the ROW to ensure safety of people and animals from EMFs as well as from direct electric shocks and "flashover".

With respect to substations, in general, the strongest EMF around the outside of a substation comes from the power lines entering and leaving the substation. The strength of the EMF from equipment within the substations, such as transformers, reactors, and capacitor banks, decreases rapidly with increasing distance. Beyond the substation fence or wall, the EMF produced by the substation equipment is typically indistinguishable from background levels (http://www.niehs.nih.gov/emfrapid).

Based on a recent in-depth review of extensive scientific literature (World Health Organisation's International EMF Project), the WHO has concluded that "despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health" (http://www.who.intpeh-emf/WhatisEMF/en.html). The low levels referred to by the WHO are levels expected to be found outside the 40m ROW proposed for the Ethiopia-Sudan Power System Interconnection Project. It is concluded therefore that provided the proposed 40m ROW is enforced along the proposed transmission line route, there will not be any adverse health affects to people along the route.

Other Environmental Impacts

The main potential adverse impacts have been identified on the basis of whether they occur during pre-construction, construction or operation in the following section. This is to facilitate implementation of mitigation measures which are outlined in the Environmental Management Plan included in Section 7.

5.2.1 Pre-Construction

Expectations of Improvement in Livelihood

These are associated with expectations of the residents of villages along the transmission alignment. Information about the interconnection spreads and each person perceives either the benefits they receive or losses. Based on such perceptions they take decisions in aniticipation of the Project benefits.

In the Project area, the information about the Project raised hopes of the villagers of power supply to their villages and anticipation of improvement in their lives. Some started to think of converting flour mills with electricity supply reducing costs of fuel. They also aniticipated a rise in trading activities as a result of construction and temporary or permanent employment.

Land, Building and other Assets Acquisition

There will be negative impacts on land associated with the construction of camps (temporary loss) and storage of construction materials, and foundations for the towers (permanent loss), especially if such construction is carried out on agriculturally productive land.

The RAP study identified that there would be permanent and temporary loss of the following assets:

It is estimated that approximately 967 ha of land will be affected by the Project, although most of this (962 ha) will be of a temporary nature during the construction and establishment of the ROW.

Only 4.48 ha of land will be permanently lost to the tower bases. This will impact upon a total of 680 households. The farming of ground crops will be allowed to continue once tower construction is completed. Disruption to crop production will therefore be experienced for a period of one year only.

TABLE 46. MATRIX OF PROJECT IMPACTS: OPTION C

Country	Route Option	Line Length (km)	No. of Towers	No. of Permanently Affected Hectares (tower bases)	No of Temporarily Affected Hectares (RoW)	No. of Buildings within Residential Households to be Permanently Relocated	Main area of impact
Ethiopia	C	296.0	603	2.95	532.0	283	Farmlands Houses Eucalytpus trees
Sudan	C	157.5 (109.5 km arable land)	312	1.53	430.0	24	
Total		**453.5**	**915**	**4.48**	**962.0**	**307**	

Most of the houses (CIS) and cottages (tukul) in the Project affected area are constructed from the same materials and according to the same design. All houses are constructed from wood with corrugated iron roofs (CIS); and all tukul are made from mud/straw with thatched roofs.

The Consultant has estimated that a total of 307 residential buildings are located within the Project ROW and will have to be relocated or demolished. Of the 307 affected houses, 283 are located within Ethiopia and 24 in Sudan. Most affected households are located within rural areas. Residences will not require full resettlement, but will be relocated to a different portion of the property or within its vicinity.

The estimated total cost of compensation for permanent and temporary loss of assets for Option C is USD 1,220,211 (Table 47). Only a relatively small portion of this amount ($99,785) applies to Sudan.

TABLE 47. TOTAL COMPENSATION COSTS FOR OPTION C

Route Option	Country	Route Section	Total
Option C	Ethiopia	1. Bahir Dar-Gonder (Azezo)	1,033,774
		2. Gonder (Azezo) –Shehedi	68,183*
		3. Shehedi-Metema	18,469
		Sub-total	**1,120,426**
Option C	Sudan	Gallabat-El Gedaref	**99,785**
		Grand Total	**1,220,211**

* Compensation estimate for adding a second circuit to the Gonder-Shehedi section single circuit line currently under construction by EEPCO.

A compensation plan, detailed budget and implementation plan for each country is included in the RAP Reports which address both permanent and temporary loss of assets.

Establishing/Pegging Final Alignment of Transmission Line

The first site activities before mobilisation of equipment will be final survey and soil investigations required for final design of line and tower foundations. After determining tower locations, and before commencement of civil works the Contractor will make a terrain reconnaissance which may include rock drilling tests at each tower location. This provides a final opportunity to make minor realignments to the route to avoid any further environmental and social impacts.

Environmental Monitoring and Management Procedures

Construction contracts will include environmental monitoring and management procedures and requirements. These must be in place prior to the commencement of any construction activities (refer Section 7).

5.2.2 Construction

Access Roads

The construction of access roads can impact the environment through vegetation clearance and compaction of land and a permanent loss of land. Provided temporary access roads are rehabilitated and existing roads/tracks are used for access to minimise the number of new roads required, the impact is not expected to be significant.

Right of Way (ROW)

Possible interference with or fragmenting of land uses along the ROW. Opening of remote lands to human activities such as settlement, agriculture, hunting and vegetation. These effects can be significant if natural areas such as wetlands or wildlands are affected, or if the newly accessible lands are home to indigenous peoples. The route along Option C is a well established corridor for transport of goods and people between Ethiopia and Sudan and the cumulative affects from the Project will not be significant.

Increased Traffic

There will be temporary minor disruptions to traffic movement, and increased safety concerns of local inhabitants and workers during construction of the transmission line as a result of increased traffic movements, particularly from large construction/transport trucks.

Construction of Campsites

Construction camps can impact the environment through vegetation clearance, compaction of land and are often a source of water pollution due to improper management of solid and liquid wastes. These impacts can be ongoing if the camps are not adequately rehabilitated after their use and adequate sanitation facilities provided during operation. Camps should also be located away from residential and other environmentally sensitive areas. Provided the mitigation measures proposed in the EMP are implemented, the impacts from temporary construction camps can be managed to acceptable levels.

Adjacent Communities

Communities affected by the construction of transmission lines expect employment, improved standard of living and business opportunities. Option C will provide local benefits to at least communities in Ethiopia since it will run in tandem with a local power transmission line currently under implementation. There is also the opportunity to provide benefits to local communities in the Sudan by supporting (through this Project) completion of the plan to provide electricity to the communities along the route from Gallabat to Gedaref. That scheme (implemented by El Gedaref State), which is partially completed, has been stopped through lack of funding.

Construction of Transmission Line Towers

Clearing of vegetation, site compaction and land acquisition has the potential to change land use patterns. However, the area required for each tower (approximately 50m^2) and the 40m ROW for the transmission line is not expected to have a major adverse impact on land use patterns since the preferred transmission line route is 321km in length and traverses a huge area in Ethiopia and Sudan.

Air and Dust Emissions

This will be an issue during the construction of access roads and clearing of vegetation along the ROW, especially since it is recommended that construction take place during the dry season. However, as most construction activities will be undertaken remote from residential areas, the impact is not expected to be major.

Noise

Noise resulting from access road and transmission line construction may disturb neighbouring communities and local fauna. This impact will be of a temporary nature only and can be minimised by adopting appropriate mitigation measures (refer to Section 7) including maintaining equipment and vehicles to manufacturers standards and limiting operating times to daylight hours.

Soil Erosion

The building of foundations for transmission line towers can potentially exacerbate soil erosion. In addition to the loss of productive land due to soil erosion and land acquisition for tower construction, soils can be impacted as a result of disposal of waste materials, and compaction with heavy machinery used for the establishment of towers and the transmission line. These impacts can be managed by restricting the use of heavy machinery and vehicles to designated work areas and installing soil protection works in areas sensitive to erosion prior to construction.

Wildlife

There are no protected wildlife conservation areas along the alignment so there is likely to be only minor impacts on wildlife during the construction phase as a result of disturbance from movement of people and machinery and loss of habitat from the establishment of the 40m ROW along the length of the route (321km). The proposed route passes mainly through a landscape that has already been greatly disturbed by mixed subsistence farming in Ethiopia and mechanised farming and mixed grazing in Sudan. Wildlife populations have already been severely impacted both in numbers and diversity.

Influx of People

Temporary influx of skilled labour during construction of transmission lines and their interaction with locals can cause tensions as well as opportunities for the spread of socially communicable diseases. These affects can be managed by appropriate ongoing consultation with local communities throughout Project construction as well as informing workers on local cultural sensitivities and health matters.

Electromagnetic Fields

The strength of both electric and magnetic fields decreases with distance from transmission lines. The proposed 40m ROW is considered sufficient to mitigate any perceived health affects from the transmission line. Further details have been provided above.

Water Resources

The construction of towers may interfere with the natural drainage systems and modify flow of surface water, and these changes can contribute to soil erosion, flooding, channel modification, downstream scouring and sedimentation in streams and other drainage channels.

Effluent discharged from temporary campsites, as well as cement slag during construction, can all pose pollution risks to streams intercepting the transmission line route. Although temporary in nature, these impacts can be ongoing if disused work sites are not rehabilitated and adequate drainage works constructed to prevent erosion. Siting of towers away from drainage lines and floodways can also minimise interference to natural drainage systems.

Safety

Construction sites pose potential hazards to both workers and nearby communities. Workers need to be instructed in safe work practices and provided with appropriate protective clothing and equipment. People from surrounding communities should be excluded from construction sites wherever possible.

Health

Influx of workers from outside communities brings risk of spreading communicable diseases such as HIV/Aids to local communities. Both workers and communities should be made aware of health implications and preventative measures provided by the Project.

5.2.3 Operation

Safety

Placement of low slung lines or lines near human activity (e.g. highways, buildings) increases the risk for electrocutions. Also, towers and transmission lines can disrupt airplane flight paths in and near airports and endanger low-flying aircraft, such as those used in agricultural management

activities. Gonder Substation, the starting point for this transmission line is located well south of the main City of Gonder and the line does not pass through any urban areas so safety impacts will be minimal for this route. A safety campaign in schools along the transmission alignment will further minimise impacts on PAPs.

Maintenance Activities

Periodic maintenance along the ROW of the transmission line will require clearing of regrowth along and adjacent to the line. This activity should be carried out in accordance with ongoing environmental management practices for the Project.

Risk of Bird Collision

Once established, the transmission line may cause increased risk of collision of birds in flight, however this risk is expected to be minimal since the route does not pass through any known migratory bird routes.

5.3 Mitigation Measures

The Environmental Management Plan outlined in Section 7 lists mitigation measures for the Project. It has been based on the following environmental management principles designed to minimise adverse impacts from the Project.

Determination of Final Alignment at Survey and design Stages

- Avoid siting transmission line through protected areas, other environmentally sensitive areas or through mature forest stands.
- Avoid cultural and heritage sites.
- Site transmission line towers on high points of land such that conductors can be strung over valleys thereby eliminating the need to remove trees.
- Locate transmission lines along the base of mountain slopes, rather than down the centre of valleys where large birds could come into contact with conductors.
- Locate transmission lines to avoid running through villages and instead run lines behind villages.
- Consult villagers regarding location of valued village resources and locate transmission lines to avoid these features.
- Situate transmission lines not far away from roads, but behind roadside forested areas so as to minimise visual intrusion.
- Minimise the need to construct new access tracks wherever possible.
- Use existing access roads and tracks wherever available.
- Ensure minimum clearance distances between conductors and ground, waterways, road crossings, buildings, communication systems etc. are incorporated into design.

Final design of the route, especially in Sudan where a route survey has not been undertaken to date should take into account the above criteria.

Construction Stage

- Limit ROW to 40m width, however, the undergrowth in the ROW should be allowed while only leaving a narrow strip to be completely cleared to allow stringing of the line conductors.
- Clear only a narrow path to facilitate pulling the nylon rope between towers to string conductors.
- Strictly define ROW clearing activities in the contract specifications and in the Environmental Management Plan (EMP).

- String conductors under tension to minimise potential damage to remaining ground vegetation.
- Use existing access roads and tracks wherever available.
- Decommission and rehabilitate excess temporary access tracks as soon as they are no longer required.
- Where access is required across agricultural lands use temporary access paths during the dry season involving placement of geo-textile over aggregates where necessary.
- Design and construct transmission line towers with staggered legs so as to eliminate the need to excavate a level pad into slopes on which to construct towers.
- Minimise the need for access tracks whenever possible.
- Construction to proceed in the dry season if possible to minimise soil erosion and mass wasting and to limit loss of crops (which are not grown in the dry season); where construction is required in the rainy season, potentially unstable slopes to be avoided.
- Scaffolding to be placed over roadways at locations conductors are being strung to ensure traffic flow is maintained and public safety is provided.

In addition to the environmental management principles outlined above, a set of best practice guidelines have been included in Appendix 6 to provide guidance for Contractors during construction. Adherence to these guidelines will further reduce the potential adverse impacts which may arise during construction.

6 Analysis of Alternatives

6.1 Environmental Impacts Identified in the 1995 Study

As mentioned previously, the 1995 investigation by IVO International included a preliminary assessment of the environmental and social impacts of the project. The assessment was undertaken largely by desktop supported by a rapid appraisal in the field (drive through inspections and fly-over) so the conclusions drawn should not be seen as providing a definitive assessment of the environmental and social impacts from the Project. The routes under the current investigation for Options C and B1/B2 are also slightly different to the original ones investigated. Relevant parts of the 1995 investigation have been included in the analysis of the alternative routes presented below.

6.1.1 Socio-economic Impacts

The least affected number of dwelling places and community service facilities (schools, mosques, churches) were found along Route B1 followed by Route A and then Route B2 which had almost three times as many dwellings affected as the other two Routes(6,350 dwellings were estimated to be affected for Route B2).

The main cultural and historical impact was identified as the adverse visual impacts from the Project on the surrounding Lake Tana landscape, an ecologically diverse and important tourist/recreation area. Lake Tana is the largest lake in Ethiopia and because of its relative shallowness it also provides important, extensive waterbird habitat. Option C2 which was shown to pass along the western foreshores of the Lake in the 1995 study, would impact significantly on the aesthetic values of the area. Under the current proposal, this route along the western foreshores of the Lake is no longer being considered. Option C route now starts at Gonder substation and proceeds directly to Metema on the Ethiopian/Sudanese border.

Health affects including an increase in communicable and social diseases were identified from the influx of an estimated workforce of 200 people during transmission line construction. Possible adverse health and safety affects from electrocution and induced affects from electromagnetic radiation were also identified although since the ROW would be mainly in relatively sparsely populated areas, the negative health and safety effects from the transmission line were considered marginal. Disruption to aircraft flight paths in and around airports and safety hazard to low flying aircraft were also identified as potential adverse impacts from the Project although the level of impact was not differentiated for the three alternative routes.

6.1.2 Bio-Physical Impacts

The report concluded that the Project would have the greatest impact on land resources mainly from construction of access roads, the transmission line and towers although the permanent loss of land was relatively very small. Land permanently lost for Options B1 and B2 was estimated to be some 65ha (half of which was classified as bush, shrub and grassland) for each Route compared to 14ha for Option A. Land temporarily affected was, however, much greater. Option A was estimated to temporarily affect some 8,000ha, over half of which was forest land and a third cultivated land. In contrast, Option B1 affected some 4,000ha and Option B2 some 3,500ha just under half of which was cultivated land.

Although Ethiopia has a rich biodiversity with a high proportion of endemic species (those only occurring naturally in Ethiopia), the impacts from the Project were assessed to be small especially with respect to Option B1. Option A was assessed to have the greater adverse impact of the three Routes considered, both with respect to Ethiopia and Sudan. This was true also with respect to making remote areas more accessible to human activities and thus increasing pressures on wildlife populations and habitat. Option A had (and still has at present) the most inaccessible route of the three Options. No designated parks or natural reserves were found to be directly affected although there was a controlled hunting area in the Dabus Valley (Route A).

The 1995 Report provided only a very brief outline of the potential adverse impacts on water quality from land clearing associated with construction of access roads, transmission line and towers. Construction camps are also a potential source of adverse water quality impacts and this

issue will be addressed in more detail for the present study, particularly in preparing the Environmental Management Plan (EMP) and in formulating environmental mitigation measures.

Option A route was also found to potentially adversely impact on the potential future exploitation of large mineral resources found in the area around Nejo and Ghimbi in Ethiopia.

6.2 Option A

6.2.1 Route Description

This route from Gedo in Ethiopia to Roseires in Sudan is 614km in length and is the longest of the alternative route Options. It initially traverses through densely populated farmland areas. For the most part, however, it passes through hunter-gatherer territory which is characterised by indigenous landscape, scattered dwellings and communal grazing lands. The main access road between Gedo and Assosa is difficult to negotiate during the rainy season although a major upgrade to an all weather road is currently underway and is expected to be completed by 2008. Topography varies along the route, particularly within Ethiopia with some areas rising above 1,000m. The topography within Sudan is more undulating and generally below 500m in altitude.

6.2.2 Environmental and Social Impacts

Due to the significantly greater length of this route, impacts such as increased construction traffic, vegetation clearing, soil erosion, construction noise will be greater and more evident over a larger area than for the other Options B1/B2 and C.

Given that there is insufficient survey data for the proposed transmission line for Option A, it is not possible to produce an exact inventory of assets damaged or lost by the Project. A rapid site survey of the route reveals that the transmission line will run through scattered farmlands (predominantly maize, teff, sorghum, coffee and sesame), woodlots (Eucalyptus and Black Wattle), plantations (Eucalyptus, Black Wattle) and communal grazing land. From Assosa, the environment changes into lowland bamboo savannah and deciduous woodland, and inhabitation becomes progressively scattered. In this section of the route, bamboo has a high economic value and is particularly threatened.

Table 47 reproduced from the RAP Report provides an estimate of assets lost by the project based on a rapid site survey and available vegetation maps.

TABLE 48. APPRAISAL OF ASSETS LOST BY THE PROJECT ALONG OPTION A

Assets lost	Percentage	Percentage per km from total of 614 km	Percentage per hectare	
			Permanent	Temporary
Farmlands (teff, maize, sorghum, sesame)	10	61.4	6.02 ha	982.4 ha
Plantations (Eucalyptus, Black wattle, Lowland bamboo)	15.5	95.17		--
Economically valuable trees (mangoes, bananas, citrus, coffee)	4	24.56		--
Communal grazing land	10	61.4	Not compensated	Not compensated
Dwellings (tukuls + CIS) and Social Services	0.5	3.07	--	--
Commercial Enterprises (kiosks, tea houses)	--	--	--	--
Indigenous forest	60	368.40	Not compensated	Not compensated
TOTAL	**100**	**614 km**		

A small number of dwellings may be affected by the line, e.g. in the vicinity of the substation at Gedo, and on the periphery of some towns and villages. However, taking the EEPCO 132kV line (existing between Gedo and Gimbi and in the process of being constructed between Gimbi and

Asosa) as the alignment for the proposed transmission line, most towns and villages will be bypassed so as to minimise impact to dwellings, social services and commercial enterprises.

6.3 Option B1/B2

6.3.1 Route Description

Option B is divided into two routes depending on starting point: The common route for the two is from the town of Chagni to Roseires in Sudan. Option B1 starts in the existing substation in Debre Markos and passes through Chagni and on to Roseires for a total of 428km. The whole of this route has been surveyed in detail. Option B2 starts at the existing substation in Bahir Dar and then passes through Chagni and on to Roseires for a total length of 405km. Only the section from Chagni has been surveyed in detail by EEPCO.

Both routes pass through heavily cultivated farmlands and large areas under commercial Eucalyptus or Black Wattle plantations. Both routes commence in high plateaus areas above 1,000m in Ethiopia but then quickly descend to lowland plains where the landscape is gently undulating and has few remaining indigenous forests. Within Sudan, no major settlements are found close to the route. The route traverses mainly mechanised farming schemes and some *Acacia senegal* plantations. There is however, a land mine area located in the vicinity of the village of Menza near the Sudan-Ethiopia border.

6.3.2 Environmental and Social Impacts

Most of the area in the highlands between Debre-Markos through Injibara to Chagni is under cultivation. There are a few isolated trees or patches left in the vicinity. For example, there are only patches of Girar (*Acacia abyssinica*), which were once common as observed in some sites, at about 35 km from Finote-Selam towards Dangla at 2550 m, which could be affected. These stands represent relicts of previously widespread species in the area.

The few patches of 'Yetan Zaf' (*Boswellia payrifera*) trees observed at about 100 km from Chagni towards Mankush, 11° 10'09.6"N and 35°51'58.8"E at 940 m could also be affected. A single large 'Zigba'' (*Podocarpus falcatus*) tree was only seen once at about 25 km from Finote-Selam towards Injibara, at about 10° 45'28.9"N and 37°02'32.7"E at 2370 m. This serves as a local source for seed collection. The Project could have an effect on the only standing tree.

Two other less common species of trees could also be affected by the Project. The large palm tree, locally known as Gusha (*Borassus aethiopum*) was only observed near Gublak River, 2 km from town, 85 km from Chagni towards Mankush, 11° 10'23.2"N and 35°59'27.9"E at 880 m. The endemic Araliaceous tree species, *Cussonia ostinii*, was only observed at 28 km from Mankush to Chagni at 11° 18'59.1"N and 35°31'38.2"E at 940 m.

A seasonal wetland observed at Teksi village, 46 km from Finote-Selam towards Dangla (2 km outside Tilili town) at 10°51'06.5''N 37°01'17.2''E, 2450 m altitude, which provides habitat for a number of bird species could be affected.

This route may have a more significant impact on birds since the section common to both Options B1 and B2 passes through some 'Important Bird Areas' in the Awi Zone.

In Sudan the route traverses mainly savannah woodland, dominated by Acacia and Incense trees, uncultivated grasslands and cultivated lands. The natural vegetation has been disturbed by clearing for agriculture, charcoal production and fire wood collection.

Based on the engineering survey alignment carried out by EEPCO in 2002, the total number of PAPs affected in Ethiopia by construction work was estimated at 275. All of the 275 PAPs will permanently lose their residential houses and/or businesses due to the construction of the transmission line.

The Consultant has estimated that 340 properties will be affected by the project, of which 235 are thatched grass roofs, 101 CIS roofs and 2 grinding mills, 1 kebele office, and 1 prison.

About 30% of those affected by the project are small businesses such as grinding or flour mills, kiosks and local eating and drinking places. The estimated compensation costs for the route in Ethiopia is summarised in the following Table reproduced from the RAP Report.

TABLE 49. SUMMARY OF COMPENSATION FOR AFFECTED ASSETS FOR OPTION B1 (ETHIOPIA)

Item for compensation	Unit	Quantity	Total cost for compensation in USD
Compensation for Houses (tukul and CIS)	No.	339	291,870.00
Compensation for loss of business (relocation, social and psychological inconveniencies)	No	55	43,154.00
Compensation for permanent loss of farmland used to grow teff	Hectare	1.25	29,000.00
Compensation for permanent loss of farmland used to grow maize	Hectare	1.25	45,517.00
Compensation for permanent loss of farmland used to grow coffee	Hectare	2.5	8,090.00
Compensation from temporary loss of land used to grow teff	Hectare	520	1,206,400.00
Compensation from temporary loss of land used to grow maize	Hectare	520	189,352.00
Compensation for loss of eucalyptus tree	No.	7535	1,550,555.00
Sub Total			**3,363,938.00**
Contingency 10%			336,393.00
Grand Total			**3,700,331.00**

Option B in Sudan traverses from the Sudan-Ethiopian border through the towns of Menza and Umjinigir; through a protected forest area near the village of Azaza, and to the substation at Roseires. The total tie-line is 82 km. The estimated compensation costs from the RAP Report are detailed in Table 50 below.

TABLE 50. SUMMARY OF COMPENSATION COSTS FOR OPTION B (SUDAN)

Types of Assets		Lost assets (ha)	Yield p/ha	Unit value (USD)	Total Compensation (USD)
Economically valuable trees	Acacia senegal	49.2	200 trees per ha	10 per tree	98,400
Permanent Crop Loss	Sesame	1.0	2 sacks per ha (X 10 annual loss)	84	3920
	Sorghum	1.0	3 sacks per ha X 10 annual loss)	42	2980
Temporary Crop loss	Sesame	3.1	2 sacks per ha	84	1218
	Sorghum	3.1	3 sacks per ha	42	882
Sub-total					107,400
Contingency (10%)					174
Total					**108,474**

Total estimated cost of compensation for the temporary and permanent loss of assets for PAPs for Option B1 is USD 3,808.805.

6.4 "Do Nothing" Option

If the Project were not to proceed a number of significant economic and environmental benefits to both Sudan and Ethiopia would be foregone. The immediate benefit to public health from the reduction of oil-based thermal generation in Sudan by the replacement of hydro-based electricity imports from Ethiopia leading to a reduction in greenhouse gas emissions and other air pollutants would not be realised. The 1995 feasibility study (IVO International 1995) estimated a potential benefit of USD 2 / kWh of avoided thermal generation. Sudan would not be able to sell this saved oil and oil products to Ethiopia and other international markets.

There would not be any increase in reliability of supply in the two Countries by taking advantage of the hydro-thermal complementarity of the two systems, and the variability of the peak demand. The two countries would not be in a position to trade energy and reserve capacity nor would they be able to coordinate and optimise the release of water from their hydropower dams.

The interconnection line is envisaged to support investments in infrastructure that will facilitate the coordinated interconnection facilities between Ethiopia and Sudan, and thus start to remove physical constraints to the integration of the power systems. It is also foreseen that the Project could be the first step towards regional power markets to utilize the enormous energy resources of the Eastern Nile Area (hydropower, geothermal, gas and oil). Neither of these benefits would be realised if the Project did not proceed.

Conversely, the adverse impacts identified in Section 5.2 would also not be realised and Project funds could be invested in alternative projects such as rural infrastructure development including roads and electrification which would bring considerable benefits to local communities.

6.5 Assessment of Alternatives

An assessment of the social and environmental impacts associated with the Project based on field inspections and literature sources indicates that most impacts associated with the Project are of a temporary nature resulting during construction and can be minimised by implementation of appropriate safeguards.

The Consultant's investigation indicates that, for the most part, the impact of the Project is expected to be temporary and acceptable provided appropriate mitigation measures are implemented. Should EEPCO proceed to construct its single circuit line along the Option C alignment, then it is expected that the Ethiopia-Sudan Power System Interconnection Project will exact minimal additional impact on affected communities and the environment beyond the construction phase.

Table 50 provides a summary of the comparison of the environmental and social impact assessments for the preferred Route (Option C) versus Options B1/B2 and A.

TABLE 51. SUMMARY OF SOCIAL AND ENVIRONMENTAL IMPACTS FOR OPTIONS A, B1, B2 AND C

Impact	Option A (614km)	Option B1 (448km)	Option B2 (425km)	Option C (446km)
Permanent loss of land to estblishment of towers (ha)	6.13	4.3	n/a	4.48
Temporary loss of land during establishment of ROW (ha)	2,456	1,353	n/a	962
Replacement of thermal generated power with hydropower, reduction in greenhouse gas emissions and other air pollutants	+++	+++	+++	+++
Increased reliability of power supply in Sudan	+++	+++	+++	+++
National economic benefit in Ethiopia and Sudan	+++	+++	+++	+++
Construction of temporary and permanent access roads leading to transmission alignment, tower sites and substations	--	-	-	-
Temporary Increased traffic due to transportation of construction and operation personnel and machinery	--	-	-	-
Site levelling and development	-	-	-	-
Clearing of vegetation in the Right of Way (ROW) and associated impacts on land use	--	-	-	-
Relocation of existing households from the site	-	--	--	-
Loss of protected forests/conservation areas/rare plants	unlikely	-	-	unlikely
Loss of endemic/migratory bird species	unlikely	-	-	unlikely
Loss of forests / economically valuable trees	---	--	--	-
Compensation for permanent loss of land or temporary loss of income	--	--	--	-
Temporary Construction traffic leading to increased traffic and safety issues for road users	-	-	-	-
Air and dust emissions during construction	-	-	-	-
Noise level during construction and operation phases	-	-	-	-
Changes in stormwater runoff due to clearing or grading, tower construction	-	-	-	-
Loss of aesthetic value	-	--	--	-
Decommissioning and disposal of substation and equipment	-	-	-	-
Health effects of electromagnetic fields (EMF) of high voltage power transmission lines outside the 40m ROW	-	-	-	-
Opening of remote lands to human activities, such as settlement, agriculture, hunting, recreation etc.	unlikely	unlikely	unlikely	unlikely
Safety issues arising from low-slung transmission lines or lines near human activity, e.g. buildings, roads	-	-	-	-
Hazards to low flying aircrafts	-	-	-	-
Cultural and interpersonal impacts of workers brought in during the construction phase	--	-	-	-
Possibilities for local employment during construction or operation	+	+	+	+

+ minor positive impact ++ medium positive impact +++ major positive impact

- minor negative impact -- medium negative impact --- major negative impact

7 Environmental Management Plan

This Section addresses mitigation measures, monitoring and institutional arrangements for the environmental management of the preferred route (Option C) 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 Ethiopia and Sudan. To ensure the effective implementation of the EMP 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. An environmental monitoring program is outlined in Section 7.4.

7.1 Proposed Environmental Management Measures

An outline of the environmental mitigation measures during the various stages of the Project is provided in the following Environmental Management Plan. It should also form the basis of the Construction Contractors EMP. The columns relating to "Contractual Clause" and "Unit Cost" can be completed during the final design stage when all works will be clearly defined.

Appendix 6 also includes a selection of "best practice" guidelines for construction acitivities which should also be included in all Construction Contracts.

Environmental Impact / Issue	Mitigation Measures	Location	Timing	Responsible Organisation		Contractual Clause	Unit Cost
				Implementation	Supervision / Monitoring		
Pre-construction Stage							
Community Consultation	Inform all communities along transmission route of schedule of implementation of Project and their rights to compensation	Throughout ROW	Before the commencement of construction	Contractor, Engineer, NEC / EEPCO	ENTRO		
Clearances, Approvals and Permits	Only licensed quarries and sand suppliers shall be used.	Throughout ROW	Before the commencement of construction	Contractor	Engineer		
	Obtain consent for borrow pit operation from the landowner with prior approval of the rehabilitation proposal of the borrow areas from the Engineer	Throughout ROW	Before the commencement of construction	Contractor	Engineer		
	Provide a copy of all necessary permits to the Engineer.	Throughout ROW	Before the commencement of construction	Contractor	Engineer		
	Adhere to all permit terms and conditions.	Throughout ROW	Throughout contact period	Contractor	Engineer		
	Obtain written permission from private landholders to conduct activities on their land prior to commencing these activities, and provide copies to the Engineer.	Throughout ROW	As required prior to commencing the intended activities	Contractor	Engineer		

Environmental Impact / Issue	Mitigation Measures	Location	Timing	Responsible Organisation		Contractual Clause	Unit Cost
				Implementation	Supervision / Monitoring		
Land and Building Acquisition	Final survey of all affected assets to update the RAP cost estimates prior to payment of entitlements. Complete all necessary land and building acquisition in accordance with RAP and entitlement Framework prior to the commencement of any construction works.	Alignment of impact	Before the commencement of construction	NEC / EEPCO	NEC / EEPCO		
	Provide copies of land acquisition details to the Engineer and Contractor.	Throughout ROW	Before the commencement of construction	NEC / EEPCO	Engineer		
Land and Building Acquisition	Provide a list of affected property owners to the RE and Contractor.	Throughout ROW	Before the commencement of construction	NEC / EEPCO	NEC / EEPCO		
Training	Organise environmental management and safety training. All Contractors and Supervising Consultant Field Supervisor/s shall attend the training.	On site	At least 1 month prior to commencement of construction	Supervision Consultant / Contractor	NEC / EEPCO		
Implementation of Environmental Management Requirements	Preparation of Contractor Environmental Management Plan	All work sites and activities	Before commencement of construction	Contractor	Engineer		

Environmental Impact / Issue	Mitigation Measures	Location	Timing	Responsible Organisation		Contractual Clause	Unit Cost
				Implementation	Supervision / Monitoring		
Health and Safety Issues	Preparation of a Health and Safety Plan for workers and impacted communities addressing issues including: • Measures to prevent the spread of HIV/Aids such as free condoms • Education of workers and impacted communties • Provision of safety equipment for workers • Use of child labour to be prohibited	All work sites	Before commencement of construction	Contractor	NEC / EEPCO		
Construction Plants, Machinery and vehicles	Trial run of Contractor's plants, machinery and vehicles for ascertaining that their emission and noise levels conform to the standards stipulated by relevant EPA.	Construction Camp / Vehicle depot	Before commencement of construction	Contractor	Engineer		
Work site Survey, Pegging and Approval	Survey the proposed alignment with a level and peg the centreline.	Beginning of ROW.	Before commencement of construction	Contractor	Engineer		
	Jointly inspect the surveyed alignment.	Along whole ROW	Before commencement of construction	Contractor / Engineer	Engineer		
	Locate, peg out and seek approval from the Engineer for each ancillary site prior to the commencement of related activities.	Throughout ROW	Before commencement of construction	Contractor	Engineer		
	Inspect and approve, if correct, all pegged ancillary sites.	Throughout ROW	Before commencement of construction	Engineer	Engineer		

Construction Stage							
Vegetation Clearance	Clearly mark out the extent of clearing within the approved worksite areas with pegs at 50-m intervals or less. Identify and mark individual trees for retention within the marked extent of clearing. Seek approval for clearing from the Engineer at least 1 week prior to any proposed clearing.	Throughout ROW	Before clearing the vegetation along a section of the road	Contractor	Engineer		
	Inspect and approve all correctly located and pegged clearing sites. Vegetation clearance shall only be undertaken once consent to clear strip plantation / individual trees along the alignment has been obtained from each owner. Instruct all construction workers to restrict clearing to the marked areas and not to harvest any forest products for personal consumption.	Throughout ROW	Before clearing the vegetation along a section of the road	Engineer	NEC / EEPCO		
	Ensure that all clearing is undertaken with minimal disturbance to the surrounding environment, within the extent of approved sites only.	Throughout ROW	Before clearing the vegetation along ROW	Contractor	Engineer		
	Stockpile cleared shrub foliage where possible within the ROW for later use as a brush layer.	Throughout ROW	Throughout construction period	Contractor	Engineer		
Construction Traffic Management							
Construction traffic causing damage to local roads due to overloading, increase in congestion, and increased road safety hazards	Contractor and subcontractors, to use appropriate vehicles, and to comply with legal gross vehicle and axle load limits. Contractor to repair damage at own expense.	Throughout Project area	Throughout Construction period	Contractor	Engineer		
Road safety hazards associated with temporary traffic diversions	Contractors to minimise road safety hazards and inconvenience to other road users by taking all appropriate measures	All traffic diversion stretches	Throughout Construction period	Contractor	Engineer		

Erosion	Clearly mark the areas to be cleared of vegetation before clearing commences. No clearing of vegetation shall occur outside of these areas.	Each 1 km of the ROW	Prior to commencement of vegetation clearing	Contractor	Engineer		
	Wherever possible avoid locating construction areas, access tracks and construction camps on steep slopes / productive agricultural land.	All Project area	Prior to commencement of construction	Contractor	Engineer		
	Identify vehicle access tracks and parking areas prior to commencement of construction. Ensure construction workers are aware of the locations of these areas and that vehicles are restricted to these areas.	All Project areas	Prior to commencement of construction	Contractor	Engineer		
	Prior to commencement of works construct necessary temporary/ permanent erosion and sedimentation control structures.	All Project areas	Prior to commencement of works	Contractor	Engineer		
	Ensure topsoil is left in a non-compacted condition following completion of works. Ensure re-vegetation at the earliest time.	At all work sites	Immediately following construction work	Contractor	Engineer		
	Following completion of works prepare areas for rehabilitation by revegetation or engage local community to plant vegetation.	At all work sites	Immediately following completion of works	Contractor	Engineer		
	Where culverts or pipes have been installed, line waterflow exit points with stone or cement rip-rap for a length of two metres.	At cross-drainage structure with erosion potential	During construction	Contractor	Engineer		
Sedimentation	Identify and map all areas where soil disturbance will occur. For each of these areas, identify appropriate sediment control structures and install structures prior to commencement of work.	Throughout alignment	Prior to commencement of construction work	Contractor	Engineer		

	If possible, schedule works requiring large areas of soil disturbance or newly formed embankments to avoid the rainy season. Where possible a bund or trench shall be constructed on the down slope of the construction areas to divert run-off to sediment control structures. The bund or trench shall be removed upon completion of construction works.	Throughout alignment At proposed cross-drainage structure locations	Prior to commencement of construction Prior to commencement of work Immediately following completion of construction	Contractor Contractor	Engineer Engineer		
Water pollution	• Ensure that potential sources of petro-chemical (including bituminous materials) pollution are handled in such a way to reduce chances of spills and leaks. • Train work crews in safe handling of petro-chemicals. • Minimise soil sedimentation as outlined under sediment control. • Contractor to make suitable arrangements for water requirements and to provide alternative supply to any users affected by contractor's abstraction of local water source.	Throughout alignment	Prior to commencement of construction	Contractor	Engineer		
Management of stockpiles, spoil heaps and batters	• Consult with nearby landholders and community about suitable locations for stockpiles and spoil heaps. • Site plans shall include all drainage provisions for construction sites. • Locate stockpiles or spoil heaps so there is no blocking of drainage lines. If stockpile locations are not level, the base shall be leveled and contained. • If a spoil heap or stockpile containing fine sediments is to remain bare during high rainfall periods, it shall be covered to prevent erosion and sediment run-off.	At potential locations for stockpiling	Prior to commencement of work Prior to commencement of work Prior to stockpiling Immediately following stockpiling	Contractor	Engineer		

	• Where spoil heaps and stockpiles are large, they must be subject to stability calculations for provision of toe wall to safeguard against slips occurring. • If local landowners or community groups plan to use spoil locally, a suitable site must be prepared to which the spoil can be dumped. • In the event of spoil being available, it shall be used to backfill waste disposal pits. These areas should then be revegetated using local communities.		Prior to stockpiling Prior to dumping of spoil Throughout construction period and upon completion of construction works	Contractor	Engineer		
Noise	• Use well maintained equipment (with mufflers where appropriate). • Use noise screens or mounds near residences, schools and health centres. • Carry out noisy construction activities during daylight. • Advise local people when there will be unusually high levels of noise.	Throughout alignment	Throughout construction period	Contractor	Engineer		
Waste management	• Contain all solid wastes at designated location within construction sites. • During site clean-up, burn all spilled fuel oils and bituminous waste materials. • Crush, burn and bury all inorganic solid waste in an approved disposal area. • Remove disabled equipment, including machinery from the area. • Use above-watertable pit latrines at major construction sites. • Compost all green or biodegradable waste.		Throughout construction During site clean-up During site clean up Throughout construction Throughout construction Throughout construction	Contractor	Engineer		

Protection of sensitive environmental areas	• Identify natural areas in site plans, especially environmentally sensitive or ecologically fragile areas. • Locate construction sites/activities away from sensitive areas. • Ensure those involved in construction are aware of these areas and the usage limits of such areas. • Provide training to construction teams to ensure an understanding of the requirements regarding environmental protection of sites.	Throughout alignment	Prior to commencement of works Throughout construction	Contractor	Engineer		
Protection of vegetation	• Identify vegetation that will need to be removed/protected. • Remove identified trees in such a way as to minimise damage to surrounding vegetation. • Ensure the construction crew is aware remaining vegetation must not be touched or damaged.	Throughout Alignment	During site preparation Prior to construction Prior to commencement of construction	Contractor	Engineer		
Worker's Camp	Contractors to prepare for approval detailed site environmental plans for the base camps and other work sites, which make adequate provision for safe disposal of all wastes, and prevention of spillages, leakage of polluting materials etc. Contractor to be required to pay all costs associated with cleaning up any pollution caused by his activities and to pay full compensation to those affected. If necessary, solid waste from the camp shall be disposed off in a 'sanitary' landfill area. The process will involve three stages: ♦ burning non-recyclable wastes in a pit ♦ crushing all un-burned residues; and ♦ burial of the crushed residues in a pit dug to avoid contamination of the water table. The pit will be covered regularly with a layer of soil or sediment.	Before construction starts Post-use of the site Camp sites	Throughout construction Throughout construction	Contractor Contractor	Engineer Engineer		

Archaeological sites	Fence off archeological sites, if any sighted / uncovered during works and report it to the appropriate authority.	At all Project sites	Prior to the commencement of works and throughout construction	Contractor	Engineer		
Socio-environmental issues	• Advise the local community of project plans in advance of construction, and involve them in the site / construction planning process. • Avoid disturbances near residential areas where possible. • Identify culturally sensitive areas and avoid disturbing them. • Control run-off and manage sediment near residential areas.	For the whole Project At all Project sites	Prior to commencement of works Throughout construction Prior to commencement of, and throughout construction Throughout construction	Contractor	Engineer		
	• Arrange for local people to be employed and trained. • Include women, poor & vulnerable groups in the implementation of the Project activities. • Negotiate and agree on with community about disposal areas and stockpile sites.	For the whole Project	Prior to commencement of, and throughout construction Prior to commencement of, and throughout construction Prior to commencement of, and throughout construction				

Drainage	• Survey and peg all designed drainage works prior to construction. Outlet drains into existing stable drainage lines, or where this is not possible, consult with adjoining downslope landowners on mutually acceptable locations for drain outlets. • Jointly inspect the pegged drainage works. • Construct all designed drainage works prior to, during or immediately following excavation work in order to minimise the erosion hazard. • Inspect all works and ancillary sites for drainage and erosion problems after each major storm event during the period of construction. Repair all failed drains and take other appropriate action as directed by the Engineer.	Throughout Alignment	Beginning with and continuing throughout construction	Contractor Engineer / Contractor Contractor Contractor	Engineer NEC / EEPCO Engineer Engineer		
Topsoil Saving and Re-use	• Save all available topsoil from within the ROW and other borrow pit areas and re-use it for site rehabilitation approved by the Engineer. • Strip and stockpile topsoil from all ancillary sites that are to be disturbed. • If topsoil is to be stockpiled, keep it separate from sub-soil material. • Sow a cover crop on each top-soiled batter within 2 days of top-soiling.	Throughout Alignment	Throughout construction	Contractor	Engineer		
Disposal of Materials	• Identify, peg and seek approval from the Engineer for permissible disposal locations. • Inspect and approve all correctly located disposal locations. • Instruct the construction workforce on the approved fill/material disposal locations and strictly supervise the correct placement of fill at these sites.	Throughout Alignment	Throughout construction	Contractor Engineer Contractor	Engineer NEC/EEPCO Engineer		

Reinstatement of Services	• Inventory all services to be reinstated.	Throughout Alignment	Prior to interruption of any services	Contractor	Engineer		
	• Liase and reach agreement with affected landowners, local authorities, public undertakings and local people regarding services to be maintained, temporarily cut and reinstated, including the timing and location of cuts and reinstatements. Obtain written permission from affected landowners / local people regarding the temporary cessation of services.			Contractor	Engineer		
	• Maintain or provide temporary services during construction, including temporary water supplies.			Contractor	Engineer		
	• Progressively reinstate or repair all interrupted services to their previous capacity.			Contractor	Engineer		
	• Inspect and certify the adequate reinstatement of services.		Following construction	Engineer	NEC/EEPCO		

Borrow Pits Loss of productive land for borrow pits and adverse financial effects associated with exploitation of naive landowners by Contractors	• Equitable agreements for borrow pit development to be reached by contractors and landowners, with post-use restoration for agriculture. Temporary lease arrangements to include an element which fully reflects post-use rehabilitation actions and costs. • Remove top soil and retain in a protected heap for post-use rehabilitation of the borrow area. • Ensure aquifers are not penetrated. • Fill excavation site with appropriate fill or incinerate construction waste in it, top and finally cover with stored topsoil. • Discuss with community possible use of excavation site for aquaculture uses. • Locate and peg borrow pits outside the ROW, estimate the quantity of material required and the period of extraction and seek approval from the Engineer. Before opening additional pits, operating pits shall be closed as per relevant Specifications. No borrow area shall be located in sensitive areas such as forests, wetland etc. • Inspect and approve all correctly located borrow pits. • Ensure that each quarry or borrow pit drains into a sediment trap before runoff is discharged off the site.	Throughout Alignment	Whenever encountered during construction	Contractor Contractor Contractor Contractor Contractor Engineer Contractor	Engineer Engineer Engineer Engineer Engineer NEC/EEPCO Engineer		

Stockpiling	• Locate, peg and seek approval from the Engineer for the use of stockpile sites. • Obtain written permission from landowners for stockpiling on their temporarily acquired land. • Inspect and approve all correctly located stockpile sites. • Seed topsoil stockpiles with a cover crop where they are to be retained for more than one month. • Site plans shall include all drainage provisions for construction sites. • Locate stockpiles or spoil heaps so there is no blocking of drainage lines. If stockpile locations are not level, the base shall be leveled and contained. • If a spoil heap or stockpile containing fine sediments is to remain bare during high rainfall periods, it shall be covered to prevent erosion and sediment run-off.	Throughout Alignment	Whenever encountered during construction	Contractor Contractor Engineer Contractor Contractor Contractor Contractor	Engineer Engineer NEC/EEPCO Engineer Engineer Engineer Engineer		
Workforce Camps	• Locate, peg and seek approval from the Engineer for workforce camp sites. • Inspect and approve all correctly located camp sites. • Provide and maintain proper drinking water, worker's health check-up, and sewage and waste disposal facilities at the camps. • recycle or dispose of solid waste as directed by the Engineer.	Construction camp lease area	Throughout construction	Contractor Engineer Contractor Contractor	Engineer NEC/EEPCO Engineer Engineer		

Workforce Management	• Liaise with affected communities regarding proposed construction activities. • Ensure workers act in a responsible manner to local people and do not harvest or take personal resources, forest products or wildlife. • Ensure that no or minimal wood is burnt by any construction workers on or off site. • Provide kerosene or gas for all workforce cooking needs. • Restrict working hours near habitations to between 06.00-18.00.	Near Construction camp sites	Before and during building of construction camps	Contractor Contractor Contractor Contractor Contractor	Engineer / NEC/EEPCO		
Dust Nuisance	• Vehicles delivering materials shall be covered to reduce spills and dust blowing off the load. • Use of water tankers to control dust at construction sites adjacent villages/houses	Throughout Alignment	Beginning with and continuing throughout construction	Contractor	Engineer		
Gaseous Air Pollution	• Vehicles and machinery will be regularly maintained so that emissions conform to National Standards.	Throughout Alignment	Beginning with and continuing throughout construction	Contractor	Engineer		
Noise	• Workers in vicinity of strong noise will wear earplugs and their working time should be limited. • Construction would be stopped from 21:00 to 06:00 hrs at construction sites located within 150 m of residential areas. • Machinery and vehicles will be maintained to keep noise at a minimum.	Throughout Alignment	Beginning with and continuing throughout construction	Contractor	Engineer		
Siltation	• Construction materials containing fine particles e.g. aggregates, limestone etc. will be stored in an enclosure away from water bodies to ensure that sediment laden water does not drain into nearby water courses.	Near cross-drainage structures and water bodies	Throughout construction	Contractor	Engineer		

	• Trees and grass will be planted on slopes and other suitable places along the alignment to stabilise works areas.	Whenever encountered during construction	Upon completion of construction activities at these sites	Contractor	Engineer		
Alteration of Drainage	• In sections along water courses, earth and construction waste will be properly disposed of so as to not block rivers and streams, resulting in adverse impact on water quality. • All necessary measures will be taken to prevent earthworks from impeding cross drainage at rivers/ streams, canal/existing irrigation and drainage systems.	Near cross drainage structures Near cross drainage structures	Whenever encountered during construction Whenever encountered during construction	Contractor Contractor	Engineer Engineer		
Contamination from Wastes	• All justifiable measures will be taken to prevent the wastewater produced at construction camps from entering directly into rivers and irrigation systems. A minimum distance of any sewage source or toilet facility should be 100m from water sources.	Near camps drainage structures and rivers/ streams	Throughout construction	Contractor	Engineer		
Contamination from fuel and lubricants	• Vehicle maintenance and refuelling will be confined to areas in construction camps designed to contain spilled lubricants and fuels. Waste petroleum products must be collected, stored and taken to approved disposal sites, according to EPA regulations.	Construction camp lease area	Throughout construction	Contractor	Engineer		

Sanitation and Waste Disposal in Construction Camps	• Camps shall be located at a minimum distance of 100 m from water sources. • Sufficient measures will be taken in the construction camps, i.e. provision of garbage tanks and sanitation facilities including septic tank and soak pits. Waste in septic tanks will be cleared periodically. • drinking water will meet National Standards. • Garbage will be collected in bins and disposed of daily. • Special attention shall be paid to the sanitary condition of camps.	At all construction and camp sites	Before and during building of construction camps Throughout construction period Throughout construction Throughout construction	Contractor	Engineer		
Increase in Water-borne, Insect-borne Communicable Diseases	• Make certain that there is good drainage at all construction areas, to avoid creation of stagnant water bodies especially in urban/industrial areas, including water in old tires. • Provide adequate sanitation and waste disposal at construction camps. • Provide adequate health care for workers and locate camps away from vulnerable groups	At all construction and camp sites	During construction	Contractor	Engineer		
Cultural Resources	• If archaeological relics or remains are discovered, the appropriate authority should be notified immediately. The construction should be stopped until the authorised organisation assesses the remains and approves continuation of work after appropriate measures are implemented. • Archaeologists will supervise any necessary excavation to avoid any damage to the relics.	Wherever such archaeological remains are discovered	Throughout construction	Contractor with National Archaeological Organisation	Engineer / NEC/EEPCO		

Hazards and Hazardous Materials	• Safely handle and store hazardous materials. • Seek directions from the Engineer for the disposal of hazardous materials. • Provide disposal directions to the Contractor when requested. • Clean up spills of hazardous materials immediately. • Suppress fires on or adjacent to construction or ancillary sites. • In case of spill of hazardous materials, relevant departments will be informed at once and will deal with it in accordance with the spill contingency plan.	Throughout Alignment Substations	Throughout construction as and when required	Contractor Contractor Engineer Contractor Contractor	Engineer Engineer NEC/EEPCO Engineer Engineer Engineer / NEC/EEPCO		
Soil Erosion	• On slopes and other suitable places along the alignment, trees and grass shall be planted • On sections with high filling and deep cutting, slopes shall be covered by mulch walls and planted with grass.	Primarily at cross drainage structures	Upon completion of construction activities at these sites	Contractor Contractor	Engineer Engineer		
Compaction of Soil	• Construction vehicles should operate within the Alignment of Impact i.e. approx. 20.0 m to either side of the centre line to avoid damaging soil, and vegetation.	Throughout Alignment especially in productive areas	During Construction	Contractor	Engineer		
Loss of trees	• Tree clearing outside ROW should be avoided beyond what is required for construction activities and / or to provide adequate conductor clearance. • All vegetated areas cleared for temporary work sites will be revegetated according to a Re-vegetation Action Plan.	Throughout Alignment Areas of proposed tree plantings	During clearing / grubbing activities After completion of construction activities	Contractor Contractor	Engineer Engineer		

POST-CONSTRUCTION (OPERATION) STAGE							
Re-vegetation	• Progressively sow all disturbed construction and ancillary site surfaces with a cover crop mix immediately following final use of each ancillary site. • Progressively implement re-vegetation works, commencing in the correct planting season. • Regularly monitor the effectiveness of re-vegetation measures.	Throughout Alignment	After completion of every 10km of ROW After completion of every 10km of ROW section Every six months for two years after re-vegetation	Contractor Contractor Contractor	Engineer Engineer NEC/EEPCO		
Hazardous Waste Management Plan	• Prepare a program to dispose of oil and other lubricants resulting from routine maintenance of generators	Substations	Prior to substations coming on line	NEC / EEPCO			
Management Plan for Maintenance of ROW	• The ROW will require periodic maintenance to maintain adequate clearance between conductors and vegetation	Along ROW	Prior to startr of operations	NEC / EEPCO			
Site decommissioning	• Establish a site revegetation plan. Where possible involve local community to provide materials and implement revegetation. The revegetation plan shall include: • Name(s) of contact landowner/community group • Summarised outcome of discussions, and decisions on what will be planted; and • List of seedlings/stock to be provided and by whom.	All ancillary sites	Immediately following completion of construction work	Contractor	Engineer		

Ancillary Site Rehabilitation	• Rehabilitate ancillary sites such as borrow areas, camp sites, material storage sites etc. within 1 month of their final use, including the removal of structures, refuse, stockpiles and other temporary features. Revegetate the sites with a cover crop and permanent vegetation as appropriate.	At all ancillary sites	Within 1 month of final use of the ancillary site	Contractor	Engineer / NEC/EEPCO		

7.2 Institutional Arrangements

The Eastern Nile Technical Regional Office (ENTRO) has been vested with the overall responsibility for the coordination, planning and implementation of the Project. The actual implementation of the environmental monitoring and management and land acquisition and resettlement components will be carried out by EEPCO and NEC in Ethiopia and Sudan respectively under formal Power Delivery, Construction and Operation agreements.

It is anticipated that construction will involve a Supervision (Management) Consultant with responsibilities under the direction of EEPCO and NEC of directly supervising the Contractor implementing the works.

In order to address the complex trans-boundary nature of the Project it is recommended that a separate environmental steering committee be established to oversee environmental monitoring and management aspects during Project implementation. In addition to ENTRO and the respective Power Authorities (EEPCO and NEC), the steering committee could include representatives from the Environmental Protection Authorities from Ethiopia and Sudan and the World Bank as financer of the Project. This would have the added benefit of ensuring a consistent approach to Project environmental matters in Sudan and Ethiopia as well as facilitating exchange of knowledge and expertise between the two countries.

Note that separate arrangements are recommended for implementation of land/assets compensation measures under the Resettlement Action Plan and these are outlined in the respective RAP Reports for Sudan and Ethiopia.

7.3 Institutional Strengthening

EEPCO has recently implemented a review of its environmental management capabilities through the Energy Access Project. The Project is a capacity-building project for the Central Work Unit and the prime objective was to develop an effective organisational structure for the Central Work Unit (CWU) to ensure effective implementation of the Environmental and Social Mitigation Plan (ESMP) in EEPCOs power projects. The Consultancy identified and assessed the staffing, training and equipment needs for the establishment of the new CWU, with particular emphasis on environmental management and community participation training.

It is recommended that the proposed resourcing and staff positions as proposed by the Consultancy be implemented to coincide with the implementation of the Ethiopia Sudan Power System Interconnection ESIA. Staff position descriptions and duties and equipment resources have been identified as part of the Consultancy and would provide a suitable model for the establishment of an environmental unit within NEC in Sudan as well.

Timing is critical in the establishment of an environmental unit in NEC since there is no current base to build from unlike EEPCO which already has an environmental unit. Monthly operating costs for the establishment of a unit with 2 Environmentalists, 1 Forester, 4 Sociologists, 1 Environmental Health Specialist, 3 Drivers and secretarial support were estimated at USD 10,000 per month. Additional funds would be required to establish field equipment and other materials.

7.4 Training

The following Table outlines the proposed training for EEPCO and NEC staff as well as employees of the Contractor. The training is aimed at the practical aspects of environmental monitoring and management.

TABLE 52. TRAINING FOR EEPCO/NEC AND CONTRACTOR STAFF

No	Training Recipients	Mode of Training	Environmental Aspects to be Covered	Training Conducting Agency
1	EEPCO and NEC Environmental Staff	Lecture System Workshops Group Discussion Visit to case study	• Environmental overview • Environmental regulations & acts • Environmental issues associated with power transmission projects • Environmental Management Plans • Environmentally sound construction management	Environmental and Social Specialists, Supervision Consultant
2	Contractor's Staff	Seminar Workshop Lectures	• Environmental overview • Environmental impact assessment • Environmental Management Plan implementation • Environmental regulations & Acts • Environmental pollution associated with power transmission projects • Environmentally sound construction management • Power transmission projects and environmental issues	Environmental and Social Specialists, Supervision Consultant EEPCO/NEC Environmental Units
3	NEC and EEPCO Operation/Maintenance Staff	Seminar Workshop Lectures	• Environmental Management Plan implementation • Environmental pollution associated with power transmission projects • Best environmental practices	Environmental and Social Specialists, Supervision Consultant EEPCO/NEC Environmental Units

7.5 Monitoring

Environmental monitoring is an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measure, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. Monitoring includes:

- Visual observations;
- Selection of environmental parameters at specific locations;
- Sampling and regular testing of these parameters.

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the Contractor at work sites during construction, under the direction and guidance of the Supervision Consultant who is responsible for reporting the monitoring to the implementing agencies, EEPCO and NEC. It is not the Contractor's responsibility to monitor land acquisition and compensation issues. It is recommended that the Contractor employ two local full time qualified environmental inspectors for the duration of the Contract (one in Sudan and the other in Ethiopia) capable of

undertaking the required monitoring or to supervise an external monitoring group (such as a university) to undertake the monitoring on behalf of the Contractor. The Supervision Consultant should include the services of an international environmental and monitoring specialist on a part time basis as part of their team.

EEPCO and NEC should in turn undertake independent monitoring of selected parameters to verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the EMP and construction contract clauses for the Project. EEPCO and NEC also have the direct responsibility to implement and monitor land acquisition and compensation issues as outlined in the RAP. Their Project teams should include an environmental monitoring and management specialist as well as a sociologist experienced in land acquisition and compensation issues. A total of 6 person months per year should be allocated by each organisation to the Project during the pre-construction and construction stages. Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

Both Sudan and Ethiopia have National EPA organisations that have the overall responsibility for issuing approval for the Project and ensuring that their environmental guidelines are followed during Project implementation. Their role therefore is to review environmental monitoring and environmental compliance documentation submitted by the implementing authorities and they would not normally be directly involved in monitoring the Project unless some specific major environmental issue arose.

Environmental monitoring of the following parameters is recommended as a minimum for the Project.

7.5.1 Water Quality Monitoring

Construction camps are often a source of significant surface and groundwater pollution if not managed and sited properly. It is recommended therefore that the Contractor undertake monitoring of any effluent, waste water, or rainfall runoff discharged from campsites. This would encourage the Contractor to implement proper wastewater treatment facilities on site through the use of settling and treatment ponds.

The parameters to be analysed should include the following:

- pH
- EC
- SS
- Turbidity
- Colour
- NH4+
- NO3-
- Total P
- Fe
- Al
- DO
- BOD
- Grease and oil
- Total coliform

If the discharged effluent does not meet the Ethiopian and Sudanese EPA standards then the Contractor must take further treatment measures or refrain from discharging effluent directly into nearby watercourses.

7.5.2 Noise Levels Monitoring

Although noise during construction is not expected to be a problem with the Project, periodic sampling of Contractor equipment and at work sites should be undertaken to confirm that it is not an issue. Noise level monitoring could be supplemented by consulting with Project Affected People in the first instance to identify the level of monitoring required.

7.5.3 Soil Erosion Monitoring

The excavation of earth for the establishment of towers, temporary and permanent access roads, work camps and storage facilities will exacerbate soil erosion. It will, therefore, be the responsibility of the Contractor's environmental inspectors to ensure the implementation and effectiveness of erosion control measures. Focus should be given to work sites where soil is disturbed and its immediate environ as well as along the ROW during and after vegetation clearing.

7.5.4 Monitoring of Vegetation Clearing

Unique stands of indigenous trees should not be removed for the establishment of towers. The Contractor's environmental inspectors should make sure that the unique tree stands identified during the present study should not be removed.

7.5.5 Monitoring Rehabilitation of Work Sites

The Contractor's environmental inspectors should ensure that areas used as temporary campsites for workers are progressively rehabilitated as they are no longer required. Once a site is rehabilitated it should be "signed off" by either EEPCO or NEC environmental staff.

7.5.6 Monitoring of Accidents/Health

The Contractor's environmental inspectors must make sure that appropriate signs are posted at appropriate locations/positions to minimise/eliminate risk of electrocutions.

In addition the environmental inspectors should make sure that:

- Measures to create awareness regarding sexually transmitted diseases, primarily HIV/AIDS, and other diseases such as malaria, schistosomiasis, leishmaniasis, and onchocerciasis are taken;
- Preventive measures to reduce/eliminate malarial, schistosomal, leishmanial, onchocercal infections where/when ever appropriate are put in place;
- Periodic health surveys are carried out along the transmission route;

EEPCO and NEC will have overall responsibility to oversee that all environmental measures are put in place and that regulations are enforced. The construction supervision consultant should assist EEPCO and NEC in this process in order to make sure that contractors fulfil the environmental requirements.

The following parameters could be used as indicators:

- Presence of posted visible signs on towers, etc.;
- Presence of sanitary facilities at campsites;
- Level of awareness of communities pertaining to dangers/risks associated with power lines;
- Presence/absence of unique stands of indigenous trees along the power line establishment route; and
- Accident reports. Records on actual accidents associated with the establishment of the transmission line could be compiled with the help of local peasant association officials, teachers/students of local schools.

TABLE 53. MONITORING PLAN

Environment Component	Project Stage	Parameter	Standard	Location	Frequency	Duration	Implement-ation	Supervision
Land Acquisition and Compensation	Pre-construction	Ensure compensation paid as per RAP	RAP	Along ROW for all PAPs	Monthly until complete		EEPCO/NEC	ENTRO
Water Quality	Construction	pH, EC, SS, turbidity, colour, NH4+, NO3-, total P, Fe, Al, DO, BOD, grease & oil, total coliform	EPA guidelines for Sudan & Ethiopia	Construction Camps	Monthly during operation of camp		Contractor	Supervision Consultant
Noise Levels	Construction	Noise levels on dB (A) scale	EPA guidelines for Sudan & Ethiopia	At equipment yards	Monthly as required by Supervision Consultant		Contractor	Supervision Consultant
		Noise levels on dB (A) scale	EPA guidelines for Sudan & Ethiopia	Noise level metre kept at a distance of 15m from edge of ROW	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	EPA guidelines for Sudan & Ethiopia	As identified by NEC/EEPCO	Pre-monsoon and post monsoon seasons		Contractor	Supervision Consultant
Vegetation Clearing	Construction	Monitor clearing to ensure consistent with EMP	EMP	Along ROW and works areas	As required		Contractor	Supervision Consultant
Rehabilitation of Work Sites	Construction	Monitoring to ensure all work sites are progressively rehabilitated	EMP	Work camps, material storage sites, along ROW	As required		Contractor	NEC/EEPCO
Health	Construction	Signs, posters displayed, health awareness lectures, mosquito nets in malarial areas for each worker, health checks for workers	EMP	Along ROW, work camps and surrounding areas	Monthly		Contractor	NEC/EEPCO
Accidents	Construction	Safety training for workers, accident reports, community consultation	EMP	Along ROW	Monthly		Contractor	NEC/EEPCO

TABLE 54. BUDGET ESTIMATE FOR MONITORING

Component	Item	Unit Cost (USD)	Quantity	Total Cost (USD)
Water Quality	At locations specified in monitoring plan	50	500 samples	25,000
Noise Levels	At equipment yards, along ROW	15	100 samples	1,500
Soil Erosion	Measurement of turbidity	10	100 samples	1,000
Contractor Staff	Environmental Inspectors	1,500 / person / month	2 full time equivalent staff for duration of Construction (10 months)	36,000
EEPCO/NEC Staff	Environmental monitoring staff	2,000 / month	1 full time equivalent staff for duration of Project (20 months)	40,000
Training	As per training program		Transport, equipment etc.	20,000

8 Conclusion

Based on field work and consultations with Project affected people, local, regional and national government agencies and other organisations it is unlikely that the Project will have significant adverse social and environmental impacts. Most 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 few adverse impacts.

Of the three alternative routes assessed during the present study, i.e. Route A (Gedo-Nekemte-Gimbi-Kurmuk-Roseires), Route B1/B2 (Debre-Markos/Bahir Dar-Injibara -Chagni-Mankush-Roseires) and Route C (Bahir Dar-Gonder-Aykel-Shehedi-Metema-Gedaref), Route C is the preferred route for the following reasons.

- Option C is considered the most cost effective of the three route options;
- It is much more accessible, more secure with high levels of traffic movement;
- The route has been under much more human development compared with Route B; it has been tampered with for centuries (Ethiopian and Sudanese history asserts this fact); hence additional impact is unlikely to cause further decline;
- The ecological mitigation measures suggested are more manageable in Route C, where:
    - Diversity sites are either extensive or absent all together (for example relatively more extensive gum Arabic trees (*Boswellia payrifera*) compared with Metekal; apparent absence of 'Important Bird Areas'.
    - Lowland bamboo in situ conservation sites are found along Routes B and A but not C;
    - A new species of herbaceous plant (*Chlorophytum serpens*) was discovered along Route B only a year ago (Sebesebe Demissew *et al*., 2005). It was not recorded along Route C;
    - Even though endemic trees were observed along all alternative routes, there were more rare species along Route B than C; for example the endemic Araliaceous tree species *Cussonia ostinii*, was only observed 28 km from Mankush towards Chagni at 11° 18'59.1"N and 35°31'38.2"E at 940 m.
- It is located in regions of Ethiopia and Sudan where there is scattered inhabitation and where there will be nominal impact to PAPs;
- No major resettlement will have to take place; households affected by the route will be shifted either to a different section of a property or within the vicinity, thus minimizing disruption to social and economic networks that are relied upon by families and individuals;
- Fewer female-headed (vulnerable) households will be affected on Option C than on the other routes;
- In Ethiopia, the transmission line will be linked to local electricity infrastructure that will provide separate, but complementary tangible Project benefits to PAPs;
- In Sudan, local electricity supply is available to part of the proposed route. The Consultant recommends that the Project set aside some budget to see to the completion of the single line circuit, thus ensuring that local villages can benefit from the Project;
- The transmission line will build upon a comparable roads and local electricity infrastructure in Ethiopia and Sudan, thus supporting the notion of an inclusive Project profile, built upon trans-boundary partnerships and exchange.

APPENDIX 1 : List of ESIA Report Preparers

Environmental and Social Impact Assessment Team

Environmental Specialist/ESIA Team Leader (Int.)	Michael Holics
Environmental Specialist (Doms.)	Dr Yagoub A. Mohamed
Socio-economic Expert (Doms.)	Prof Hassan M. Salih
Biologist/Ecologist (Doms.)	Prof Shibru Tedla
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Health and Safety Specialist (Doms.)	Mitra Delri
Environmental Economist (Doms.)	Abdulahi Mohammed Yimam
Legal Specialist (Doms.)	Michael Gunta
Public Consultation Specialist (Doms.)	Abdel S S Bazaraa
Archaeological Specialist (Doms.)	Dr Intisar Soghayroun
Remote Sensing and GIS Specialist (Doms.)	Sayid A Malik
Telecommunication Specialist (Doms.)	Saad Yousif A. Aziz
Envirnomental Impact Specialist (Doms.)	Arebo Sambi

Resettlement Action Plan Team (prepared separate RAP Report)

Resettlement Specialist/RAP Team Leader (Int.)	Dr Angela Impey
Resettlement Specialist (Doms.)	Mamoun E. Mohamed
Socio-economic Expert (Doms.)	Assefa Adisu
Legal Specialist (Doms.)	Adil E. Ahmed
Archaeological Specialist (Doms.)	Prof Ali Osman M Salih
Resettlement Specialist (Doms.)	Dr Mustafa Babiker

APPENDIX 2 : Reference Material

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APPENDIX 3 : Record of Consultation

List of Meetings and Contacts

Date	Name	Title/Organization	Contact Details
ETHIOPIA, Addis Ababa			
3 August 2005	**Ato Mekuria Tafesse**	**Executive Director, ENTRO**	**Tel: (251 1) 2515660 Fax: (251 1) 2515681**
3 August 2005	**Dr Ahmed Khalid Eldaw**	**Senior Regional Projects Coordinator, ENTRO**	**Tel: (251 1) 461130 Fax: (251 1) 459407**
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3 August 2005	**Dr Fatma Moustafa**	**PCU Manager, ENTRO**	**Tel: (251 1) 461130 Fax: (251 1) 459407**
12 August 2005	**Ato Tesfaye Batu**	**Project Manager, Ethiopia-Sudan Power System Interconnection Project**	**EEPCO Mob: (09) 254408 Tel: (01) 517169 Fax: (01) 517198**
17 August 2005	**Ato Solomon Giorgis**	**Manager, Survey Division**	**EEPCO Mobile: 09/229810**
18 August 2005	**Ato Yusuf Haji Ali**	**Power Engineer**	**World Bank Tel: (01) 176089/627700 Fax: (01) 627717**
18 August 2005	**Ato Negede Lewi**	**Engineer Transport Sector**	**World Bank Tel: (01) 176089 Fax: (01) 627717**
19 August 2005	**Ato Solomon Desta**	**Project Manager Gonder (Azezo)-Metema Transmission Line**	**EEPCO, Mobile: 09/678276 Office: 526522**
19 August 2005	**Ato Girma Mekunia**	**Division Manager, Power System Design Division**	**EEPCO**
19 August 2005	**Ato Fekade**	**Agent**	**ENERGO INVEST**
Gonder (Azezo)			
21 August 2005	**Ato Mamush Walelegn**	**Soil Investigation Technician**	**EEPCO**
21 August 2005	**Ato Worku Taffere**	**Supervisor**	**ENERGO INVEST (Contractor)**
23 August 2005	**Ato Sisay Yehuala**	**Environmental Protection and Land Administration and Use Expert**	**Gonder (Azezo) Woreda Agricultural Bureau Mobile: 09-442135**
Chilga			
23 August 2005	**Ato Engida Work Gezahagu**	**Information Officer**	**Chilga Woreda Information Bureau Tel: 08-330054**
Bahir Dar		**Regional Office for Agriculture and Rural Development Department**	
23 August 2005	**Ato Belayneh Ayele**	**Environmental Expert**	**Mobile: 09-442135**
23 August 2005	**Ato Tekul Damte**	**Ecologist**	**Tel: 08-207235**
23 August 2005	**Ato Hunegaw Sharew**	**Legal Advisor**	
23 August 2005	**Ato Getahun Alemneh**	**Land Administration Expert**	**Tel: 08-207234**
	Bidar		
	Metema	**Kebele**	
22 August 2005	**Ato Nega Abdukadir**	**Representative**	
Debre Markos			
25 August 2005	**Ato Zezalem Kassa**	**Operator Debre Markos Substation**	**EEPCO Tel: (08) 7111138**
SUDAN			

10 Sep 2005	Eng. Sir El Khatin Eisa	Distribution Engineer, NEC El Gedaref	
11 Sep 2005	Adel Moneim Mohamed Abdalla	Executive Director Gallabat Locality, Gedaref State (located in Doka Village)	
12 Sep 2005	Eng. Yassin Abdel Rahman	Deputy Director Transmission Lines, Damazin – Blue Nile State (NEC), Damazin	
13 Sep 2005	Suleiman Hamad El Nil	A native of Mukla Village (now working for NEC at Roseires)	
13 Sep 2005	Ibrahim Dafalla Ali Mohamed	Sheik of Azaza Village and Chair of Azaza Peoples Committee, Sudan	
13 Sep 2005	Peter Ani	Member of Azaza Village Peoples Committee	
13 Sep 2005	Abdel Aziz El Amin	OMDA of Kadaldo Village, Sudan	(+249 91) 258 1402
1-3 Oct 2005	Osama Dorzon	Secretary General, Gedaref Farmers Union	
1-3 Oct 2005	Karamalla Mohamed	Chairperson, Gedaref Farmers Union	
1-3 Oct 2005		Mechanised Agricultural Corporation Inspectors, Gedaref	
1-3 Oct 2005		Osar Village, Peoples Village Committee	
1-3 Oct 2005		Osar Village Sheikhs	
1-3 Oct 2005	Humeide El Dai Ibrahim	Chairperson Kassab Village People Committee and Chairperson of Local Court	
1-3 Oct 2005	Abdallah Karrar Abdelwahid	Sheikh of Kassab	
1-3 Oct 2005	Omer Mohammed Shegeibo	Sheikh of Elsabonei Village	
1-3 Oct 2005	Hussein Guma'a	Sheikh of El Hamra Village	
1-3 Oct 2005	Guma'a Hamza	Chairperson, El Hamra Peoples Committee	
1-3 Oct 2005	Arbab Idris Haroun	Sheikh of Towarreet Village	
1-3 Oct 2005	Mohammed Zakaria	Sheikh of Saraf Saeed Village	
1-3 Oct 2005	Mohammed Abakar Eisa and Ibrahim Mohammed Taha	Sheikhs of Olam Village	
1-3 Oct 2005	Ali Daneen	Sheikh of Otrob Village	
1-3 Oct 2005	Abdel Samei Ahmed Mohammed Bahr	Deputy Nazir, Chairperson Peoples Committee and Chairperson of Local Court in Gallabat	
1-3 Oct 2005	Abdel Muneim Ahmed Balla	Executive Officer, Gallabat locality in Doka	
1-3 Oct 2005		Gedaref Farmers Union	
1-3 Oct 2005		Gedaref Pastoralists Union	
1-3 Oct 2005		Village Popular Committees	
1-3 Oct 2005		Gallabat Locality Legislative Council	
1-3 Oct 2005		Youth and Women Associations	
ETHIOPIA			
4 Oct 2005	Ato Reynold Duncan	Lead Power Engineer, Finance, Private Sector & Infrastructure Group	(+1 202) 458 4609

		Middle East & North Africa Region World Bank	
Benishangul-Gumuz			
5 Oct 2005	**Mekonnen Kifle**	**Gedo Substation Technician, EEPCO**	
7 Oct 2005	**Ato Kinde Haile**	**Rural Development Advisor to the President of Benishangul-Gumuz Regional State**	
7 Oct 2005	**Ato Berhanu Garno**	**Head, Bureau of Finance & Economic Development, Benishangul-Gumuz Regional State**	**(+251 11) 275 0211**
7 Oct 2005	**Ato Mesfin Kebede**	**Manager, EPA, Benishangul-Gumuz Regional State**	**(+251 57) 775 1292**
7 Oct 2005	**Ato Teshale Tesfaye**	**Team Leader, Food Security & Resettlement, Benishangul-Gumuz Regional State**	
8 Oct 2005	**Ato Kabachi Yousif**	**Administrator, Kurmuk Woreda**	
9 Oct 2005	**Ato Asfau Kena'a**	**Ethiopian Evangelical Church, Mendi**	**(+251 57) 776 0821**
10 Oct 2005	**Ato Kelil Shifa**	**Administrator, East Wollega Zone, Nekemte**	**(+251 57) 661 1157**
10 Oct 2005	**Ato Assfau Guye**	**Expert for Forest Protection & Development, Guto Wayu Woreda, Nekemte**	
18 Oct 2005	**Ato Girma Demissie**	**Manager, Environmental Monitoring Unit, EEPCO**	**(+251 11) 155 6605**
18 Oct 2005	**Ato Yohannes Yoseph**	**Forester, EMU EEPCO**	**(+251 11) 156 2050**
18 Oct 2005	**Ato Kidane Gizaw**	**Environmentalist, EMU EEPCO**	**(+251 11) 156 2050**
Bahir Dar-Gonder (Azezo)			
8 February 2006	Ato Tesfaye Batu	Project Coordinator	
10 February 2006	Ato Tsfaye G/ Meskel	EEPCO Senior Surveyor	
10 February 2006	Ato Minase Merawi	EEPCO Senior Surveyor	
10 February 2006	Ato Aynalem Bekele	EEPCO Senior Surveyor	
10 February 2006	Ato Girma Mekuria	EEPCO Power System Design Division	
13 February 2006	Ato Admasu Mola Fetene	Bahir Dar EPA, ASIA Department Head	
13 February 2006	Ato Workineh Andarge	Bahir Dar EPA,Environmental and EIA Team Leader	
13 February 2006	Ato Bayeh Tiruneh	Bahir Dar , EPA Land Use Department Head	
13 February 2006	Ato Gashaw Zewdu	Bairdar Zone, Development and agriculture office	
13 February 2006	Getachew Nigatu	Bahir Dar Zone, Rural Development and Agriculture office	
13 February 2006	Ato Workineh Mulu	Bahir Dar Zone, Rural Development and Agriculture office	
14 February 2006	Ato Tsfaye Kebede	South Gonder (Azezo), Woreta, Planning and Finance Department	
14 February 2006	Ato Osman Issa	South Gonder (Azezo), Woreta, Planning and	

		Finance Department
15 February 2006	Ato Birhanu Temesgen	South Gonder (Azezo), Maksegnit woreda Rural Development and Agriculture
15 February 2006	Ato Merkeb Eshete	South Gonder (Azezo), Maksegnit woreda Rural Development and Agriculture
15 February 2006	Ato Getnet Abe	South Gonder (Azezo) Health Bureau
15 February 2006	Ato Aye Zerihun Etsub	South Gonder (Azezo), Rural Development and Agriculture
15 February 2006	W/T Askale Girmaye	South Gonder (Azezo), Rural Development and Agriculture Bureau
15 February 2006	Ato Dareskedar	North Gonder (Azezo), Libokemkem woreda, Rural Development and Agriculture
15 February 2006	Ato Fisiya Fikadu	North Gonder (Azezo), Libo Kemkem woreda Health Bureau
SUDAN 2006		
19 July 2006	Ishag Abdalla Bakhit,	NEC Survey Department, Khartoum
24 July 2006	Salah Awad Bashir,	Director, Survey Dpot, Gedaref State
23 July 2006	Badereldin Mohamed Ahmed	Director of Operations, NEC, Gedaref
23 July 2006	Eisa Omer Eisa	Director of Crop Markets, Gedaref State
24 July 2006	Hassan Abbo Siddig	Chairperson, Basunda Pastoral Union, Gallabat Locality
24 July 2006	Abdelsamie Awad Bahr	Chair, Gallabat Popular Committee
24 July 2006	Gaafar Hamad El Neel	Olocal Notable, Gallabat

APPENDIX 4 : Baseline Data Tables

Biological Environment

TABLE 55. FLORA BETWEEN GONDER AND METEMA (OPTION C) RECORDED DURING PRESENT SURVEY.

No.	Scientific Name	No.	Scientific Name
1.	*Acacia abyssinica*	48.	*Juniperus procera*
2.	*A. hockii*	49.	*Justicia schimperiana*
3.	*A. polyacantha*	50	*Lannea fruticosa*
4.	*A. seyal*	51.	*Loudetia arundiaceae*
5.	*Adansonia digitata*	52.	*Maesa lanceolata*
6.	*Albizia gummifera*	53.	*Maytenus obscura*
7.	*A. malacophylla*	54.	*M. senegalensis*
8.	*Allophylus abyssinicus*	55.	*M. serrata*
9.	*Aloe trigonantha*	56.	*Milletia ferruginea*
10.	*Anogeissus leiocarpa*	57.	*Olea europea ssp. Cuspidate*
11.	*Balanites aegyptiaca*	58.	*Otostegia integrifolia*
12.	*Bersama abyssinica*	59.	*Panicum comorons*
13.	*Boswellia papyrifera*	60.	*Pavetta gardenifolia*
14.	*Brucea antidysenterica*	61.	*Pennisetum polystachion*
15.	*Calpurnia aurea*	62.	*P. ramosum*
16.	*Capparis tomentosa*	63.	*P. Schweinfurthii*
17.	*Carissa edulis*	64.	*P. sphacelatum*
18.	*Cenchrus ciliaris*	65.	*Phoenix reclinata*
19.	*Chenopodium ambrossoides*	66.	*Phytolacca dodecandra*
20.	*Combretum aculeatum*	67.	*Piliostigma thonningi*
21.	*C. collinum*	68.	*Pittosporum viridiflorum*
22.	*C. hartmannianum molle*	69.	*Podocarpus falcatus*
23.	*C. molle*	70.	*Prunus Africana*
24.	*C. rochetiana*	71.	*Pseudocedrella kotschyii*
25.	*Cordia Africana*	72.	*Pterolobium stellatum*
26.	*Croton macrostachyus*	73.	*Pterocarpus lucens*
27.	*Cynodon dactylon*	74.	*Rumex nervosus*
28.	*Dalbergia melanoxylon*	75.	*Rosa abyssinica*
29.	*Dichrosthchys cinerea*	76.	*Salix subserrata*
30.	*Dombeya torrida*	77.	*Schefflera abyssinica*

No.	Scientific Name	No.	Scientific Name
31.	*Dracaena steudneri*	78.	*Securidaca longpedunculata*
32.	*Ekerbergia capensis*	79.	*Sesbania sesban*
33.	*Embelia schimperi*	80.	*Senna didymobotrya*
34.	*Entada abyssinica*	81.	*S. petersiana*
35.	*E. Africana*	82.	*Sterculia setigera*
36.	*Erythrina brucei*	83.	*Sterospermum kunthianum*
37.	*E. abyssinica*	84.	*Strychnos innocua*
38.	*Euphorbia candelabrum*	85.	*Syzygium guineense*
39.	*Ficus sycomorus*	86.	*Tamarindus indica*
40.	*F. thonningii*	87.	*Terminalia laxiflora*
41.	*F. vasta*	88.	*Turrea holstii*
42.	*Flueggea virosa*	89.	*Verbascum sinaiticum*
43.	*Gardenia ternifolia*	90.	*Verbena officinalis*
44.	*Grewia mollis*	91.	*Vernonia amygdalina*
45.	*G. trichocarpa*	92.	*Ximenia americana*
46.	*Hypericum sp.*	93.	*Ziziphus abyssinica*
47.	*Jasminum abyssinicum*	94.	*Z. mauritianiana*

TABLE 56. LIST OF FLORA BETWEEN DEBRE-MARKOS AND MANKUSH (OPTION B1) RECORDED DURING PRESENT SURVEY.

No.	Scientific Name	No.	Scientific Name
1.	*Acacia abyssinica*	44.	*Flueggea virosa*
2.	*A. hockii*	45.	*Gardenia ternifolia*
3.	*A. polyacantha*	46.	*Grewia mollis*
4.	*A. seyal*	47.	*Hygrophila auriculata*
5.	*Acanthus senni*	48.	*Ipomoea aquatica*
6.	*Albizia gummifera*	49.	*Juniperus procera*
7.	*A. malacophylla*	50.	*Justicia schimperiana*
8.	*Allophylus abyssinicus*	51.	*Laggera tomentosa*
9.	*Anogeissus leiocarpa*	52.	*Lannea fruticosa*
10.	*Arundinaria alpina*	53.	*Loudetia arundinaceae*
11.	*Balanites aegyptiaca*	54.	*Maesa lanceolata*
12.	*Borassus aethiopum*	55.	*Maytenus obscura*
13.	*Boswellia papyrifera*	56.	*M. senegalensis*

No.	Scientific Name	No.	Scientific Name
14.	*Breonadia salicina*	57.	*Olea europaea ssp. cuspidata*
15.	*Bulbophyllum sp.*	58.	*Oxytenanthera abyssinica*
16.	*Calpurnia aurea*	59.	*Pennisetum polystachion*
17.	*Capparis tomentosa*	60.	*P. ramosum*
18.	*Carissa edulis*	61.	*P. schweinfurthii*
19.	*Cissus populinea*	62.	*P. spacelatum*
20.	*Chenopodium ambrossoides*	63.	*Phoenix reclinata*
21.	*Clausena anista*	64.	*Phytolacca dodecandra*
22.	*Combretum collinum*	65.	*Piliostigma thonningi*
23.	*C. hartmannianum*	66.	*Pittosporum viridiflorum*
24.	*C. molle*	67.	*Podocarpus falcatus*
25.	*Cordia Africana*	68.	*Polystachya sp.*
26.	*Cotula abysinnica*	69.	*Prunus africana*
27.	*Croton macrostachyus*	70.	*Pseudocedrella? kotschyii*
28.	*Cynoglosum geometricum*	71.	*Rumex nepalensis*
29.	*Cussonia ostinii*	72.	*Rhus ruspolii*
30.	*Cynodon dactylon*	73.	*Rosa abyssinica*
31.	*Dalbergia melanoxylon*	74.	*Salix subserrata*
32.	*Dichrosthchys cinerea*	75.	*Sapium ellipticum*
33.	*Dombeya torrida*	76.	*Schefflera abyssinica*
34.	*Dracaena steudneri*	77.	*Securidaca longpedunculata*
35.	*Echinops amplexicaulis*	78.	*Sesbania sesban*
36.	*Embelia schimperi*	79.	*Sterculia setigera*
37.	*Entada abyssinica*	80.	*Sterospermum kunthianum*
38.	*E. africana*	81.	*Strychnos innocua*
39.	*Erythrina brucei*	82.	*Syzygium guineense*
40.	*E. abyssinia*	83.	*Tamarindus indica*
41.	*Ficus sycomorus*	84.	*Terminalia sp.*
42.	*F. thonningii*	85.	*Turrea holstii*
43.	*F. vasta*	86.	*Tylosema fassoglensis*

TABLE 57. LARGER WILDLIFE SPECIES REPORTED TO BE PRESENT IN THE PROJECT AREA (PERSONAL COMMUNICATION WITH EWNHS AND OTHERS).

No.	Common Name	Species	Remark
1	Greater Kudu	Tragelaphus strepsiceros	
2	Bushbuck	*Tragelaphus scriptus*	
3	Klipspringer	*Oreopus oreotragus*	
5	Bush Duiker	*Sylvicapra grimmia*	
6	Grant's Gazelle	*Gazella granti*	
7	Bush Pig	*Potamochaerus larvatus*	
8	Warthog	*Phacochoerus africanus*	
9	Civet cat	*Viverra civetta*	
10	African serval	*Leptailurus serval*	2 Seen on mission, Pawe to Mankush
11	Spotted Hyena	*Crocuta crocuta*	
12	Side-stripped Jackal	*Canis adustus*	Seen on mission
13	Black-backed Jackal	*Canis mesomelas*	
14	Anubis Baboon	*Papio anubis*	
15	Colobus monkey (Gurezza)	*Colobus gureza*	Seen on mission
16	Vervet Monkey	*Cercopithecus aethiops*	Seen on mission
17	Dormouse	*Graphiurus parvus*	
18	Hyrax	*Procavia capensis*	Seen on mission
19	Aardvark	*Orycteropus oreotragus*	
20	Hippopotamus		
21	Lion	Panthera leo	Reported by a resident of Chagni
22	Leopard	*Panthera pardus*	Reported by a resident of Chagni
23	African Elephant	*Loxodanta africana*	Reported by a resident of Chagni

TABLE 58. BIRDS ENCOUNTERED DURING THE PRESENT STUDY WHILE DRIVING THROUGH THE AREA ADJACENT TO ROUTES B AND C, WALKING THROUGH BUSH/FOREST, OBSERVING RIVER COURSES AND VISITING CHURCHYARDS AND MOSLEM BURIAL SITES.

No	Common Name	Species	Location	Remark
[1]	Great White Pelican	*Pelecanus onocrotalus*	Enjebara to Chagni	2 only
2	Cattle Egret	*Bubulcus ibis*	Many places	Very many
3	Black Stork	*Ciconia nigra*	Near Chagni	2 only
4	Hamerkop	*Scopus umbretta*	Many places	More than a dozen
5	Wattled Ibis	*Bostrychia carunculata*	Many places	Very many
6	Hadada Ibis	*B. hagedash*	Many places	Very many
7	Sacred Ibis	*Threskiormis aethiopica*	Many palces	Very many
8	Western Honey Buzzard	*Pernis apivorus*	Around Pawe	Few
9	Hooded Vulture	*Necrosyrtes monachus*	Pawe to Guba, Gonder to Metema	About a dozen
10	Short-toed Snake Eagle	*Circaetus gallicus*	Pawe to Mankush; Gonder to Metema	About a dozen
11	Dark Chanting Goshhawk	*Melierax metabates*	Gonder to Metema	Very few
12	Booted Eagle	*Hieraaetus pennantus*	Gonder to Metema	Very few
13	Scaly Francolin	*Francolinus squamatus*	Pawe to Mankush	Very many
14	Helmeted Guineafowl	*Numida melagris*	Pawe to Mankush	Very many
15	Common Quail	*Coturnix coturnix*	Pawe to Mankush	Many
16	Watled Crane	*Bugeranus carunculatus*	Pawe to Mankush; Gonder to Metema	Few
17	Specled pigeon	*Columbia guinea*	Shehadi	Many
18	Blackwinged Lovebird	*Agapornis taranuta*	Gonder to Metema	Many
19	Rose –Ringed Parakeet	*Psittacula krameri*	Gonder to Metema	Few
20	Blackbilled Turaco	*Tauraco schuetti*	Gonder to Metema	Few
21	Black and White Cucoo	*Oxylophus jacobins*	Gonder to Metema	Few
22	White throated beater	*Meropis albicollis*	Gonder to Metema	Few
23	Abyssinian roller	*Coracias abyssinica*	Gonder to Metema	Few
24	African Grey Hornbill	*Tockus deckeni*	Gonder to Metema	Few
25	Eastern Yellow-billed Hornbill	*Tockus flavirostris*	Metema	Few
26	Long-tailed Widow Bird	*Euplectes progne*	Enjebara- Chagni Gonder-Aykel	Few
27	Magpie Shrike	*Corvinella corvina*		Few
28	Fan Tailed Raven	*Corvus crassirostris*		
29	Pied Crow	*Corvus albus*	Debre-Markos to Chagni Gonder to Aykel	Very many
30	White-naked Raven	*Corvus albicollis*	Debre-Markos to Chagni Gonder to Aykel	Very many
31	Long Tailed Hawk	*Urotrichorchis macrourus*	Aykel to Metema; Chagni to Mankush	few

No	Common Name	Species	Location	Remark
32	Purple headed Glossy Starling	*Lamprotorms purpureiceps*	Debre-Markos to Chagni Gonder to Aykel	Very many
33	Acacia Paradise Whydah	*Vidua paradisaea*	Debre-Markos to Chagni Gonder to Aykel	Many
34	Pin Tailed Whydah	*Vidua macroura*	Debre-Markos to Chagni Gonder to Aykel	few
35	Northern Red Bishop	*Euplectes franciscanus*	Aykel to Metema	Many
36	Speckled Tropical Boubou	*Laniarius ferrgineus*		Many
37	Ring-necked Dove	*Stretopeliaca picola*	Aykel to Metema	
38	Black-headed Oriol	*Oriolus larvatus*		Many
39	Paradise Fly-catcher	*Terpsiphone viridish*	Pawe to Mankush; Aykel to Metema	Many
40	Black-headed weaver	*Plocerus cucullatus*	Pawe to Mankush; Aykel to Metema	Very many
41	Red-billed Hornbill	*Campethera nubica*	Debre-Markos to Chagni	four
42	Finches		Chagni to Mankush and Aykel to Metema	
43	Gordon Blues		Chagni to Mankush and Aykel to Metema	Many
44	Weavers		Pawe to Mankush; Aykel to Metema	Very many
45	Firefinches		Pawe to Mankush; Aykel to Metema	Very many
46	Starlings		Debre Markos-Mankush; Gonder-Metema	Very many
47	Sunbirds		Debre Markos-Mankush; Gonder-Metema	Many
48	Pigeons		Debre Markos-Mankush; Gonder-Metema	Many
49	Doves		Debre Markos-Mankush; Gonder-Metema	Very many
50	Orioles		Pawe to Mankush; Aykel to Metema	Many
51	Flycatchers		Pawe to Mankush; Aykel to Metema	Many

TABLE 59. LIST OF SOME SPECIES OF BIRDS OCCURRING IN BENISHANGUL-GUMUZ REGION IN ETHIOPIA (OPTION A AND B PASS THROUGH THIS REGION). SOURCE: UNPUBLISHED REPORT BY HERMAN, 2001.

Common Name	**Species**
Secretary bird	*Sagittarius serpentarius*
Ostrich	*Struthio camelus*
Little Grebe	*Trachybaptus ruficollis*
Black-Necked Grebe	*Podiceps nigricollis*
Great Crested Grebe	*Podiceps cristatus*
Great Cormorant	*Phalacrocorax carbo*
Long-Tailed Cormorant	*Phalacrocorax africanus*
Great White Pelican	*Pelecanus onocrotalus*
Pink-Backed Pelican	*Pelecanus rufescens*
African Darter	*Anhinga rufa*
Little Egret	*Egretta dimorpha*
Great White Egret	*Egretta alba*
Yellow-Billed Egret	*Egretta intermedia*
Black Heron	*Egretta ardesiaca*
Cattle Erget	*Bulbulcus ibis*
Green-backed Heron	*Butorides striatus*
Common Bittern	*Botaurus stellaris*
Little Bittern	*Ixobrychus minutus*
Dwarf Bittern	*Ixobrychus sturmii*
Squacco Heron	*Ardeola ralloides*
Black-Crowned Night Heron	*Nycticorax nycticorax*
Goliath Heron	*Ardea goliath*
Grey Heron	*Ardea cincera*
Black-Headed Heron	*Ardea melanocephala*
Purple Heron	*Ardea pupurea*
White Stork	*Ciconia ciconia*
Black Stork	*Ciconia nigra*

Figures

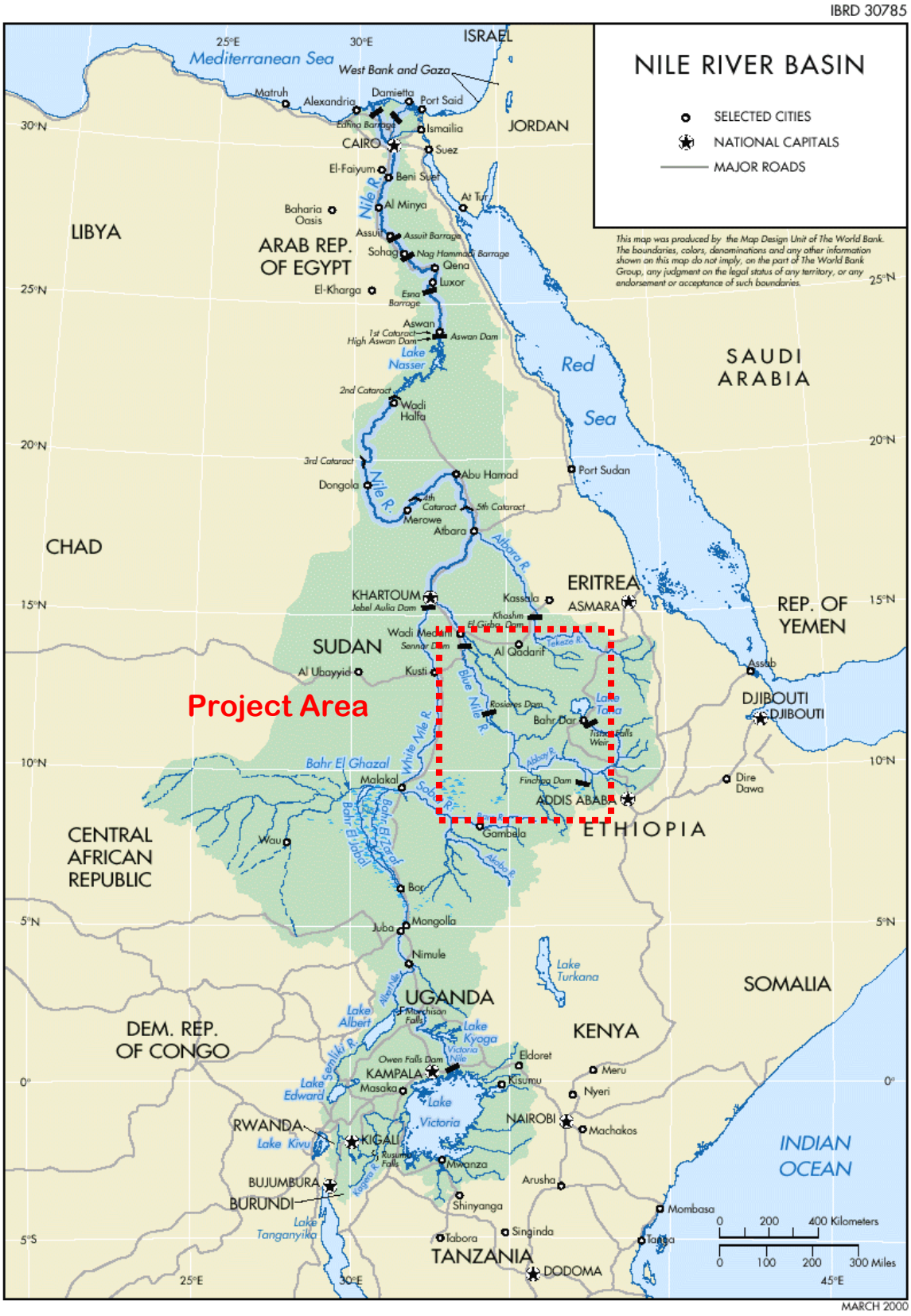

Figure 1. Regional Location of the Ethiopia-Sudan Power System Interconnection Project

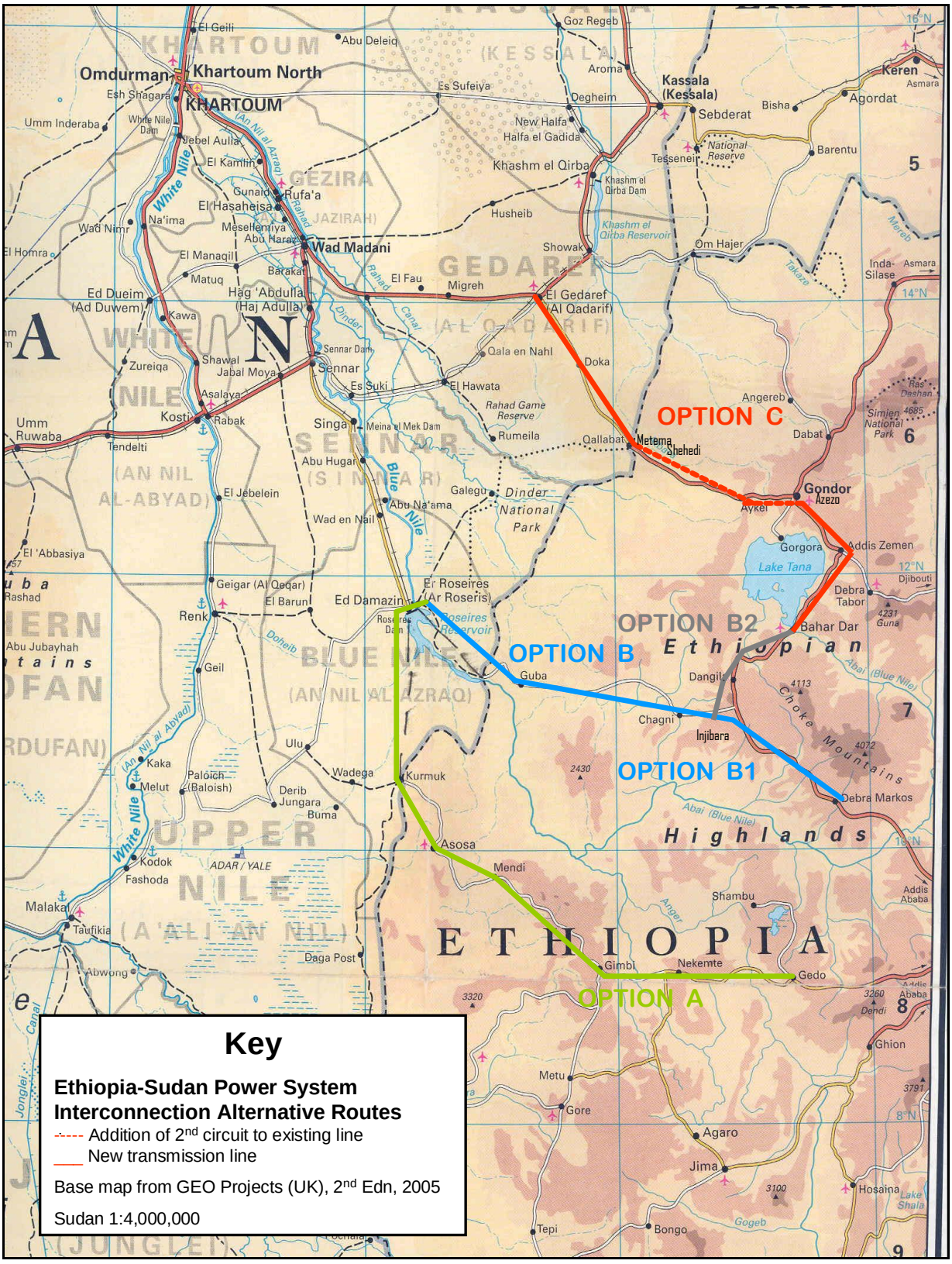

Figure 2. Location of alternative transmission line routes between Ethiopia and Sudan.

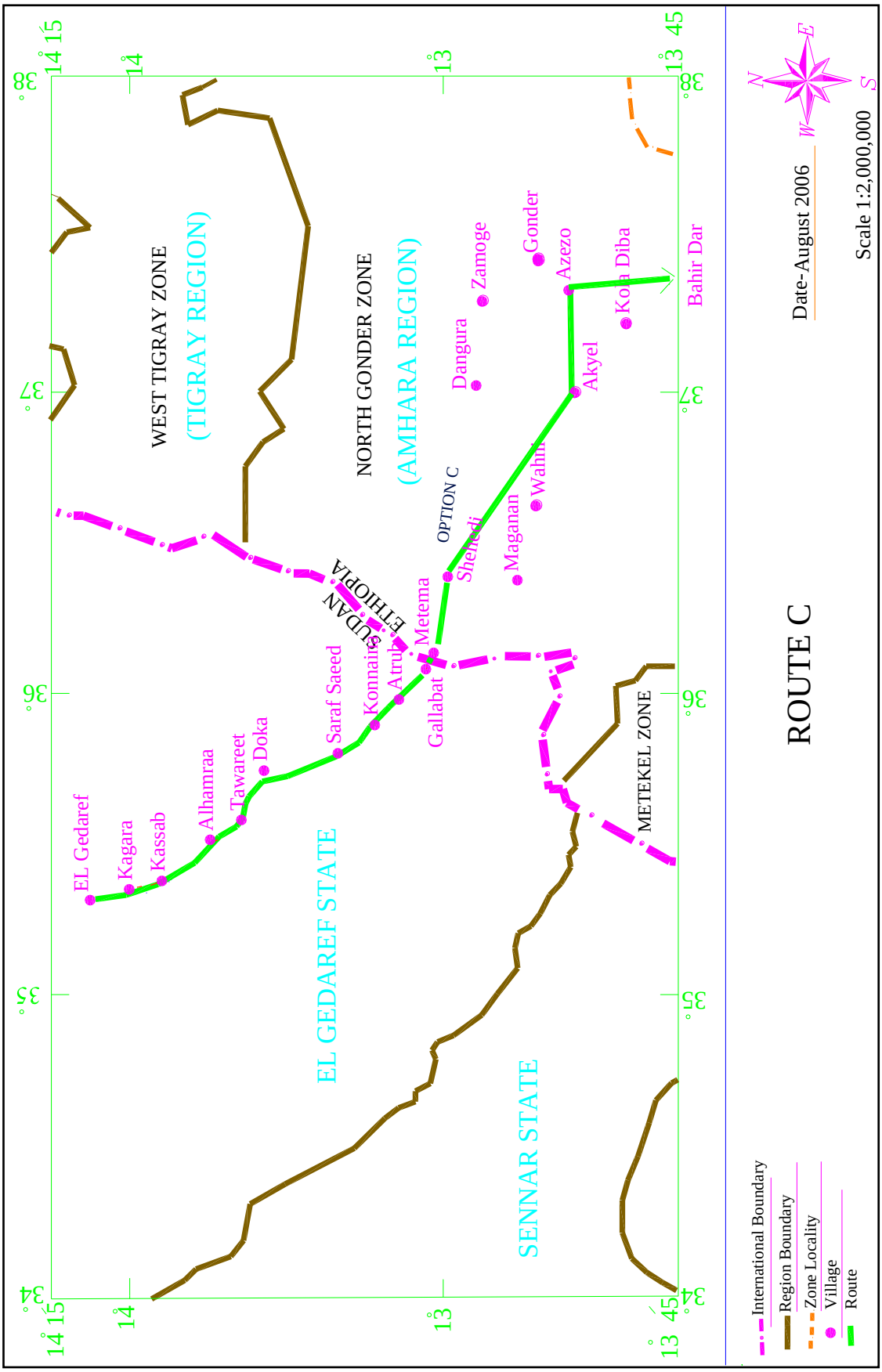

Figure 3. Option C route showing administrative areas and villages.

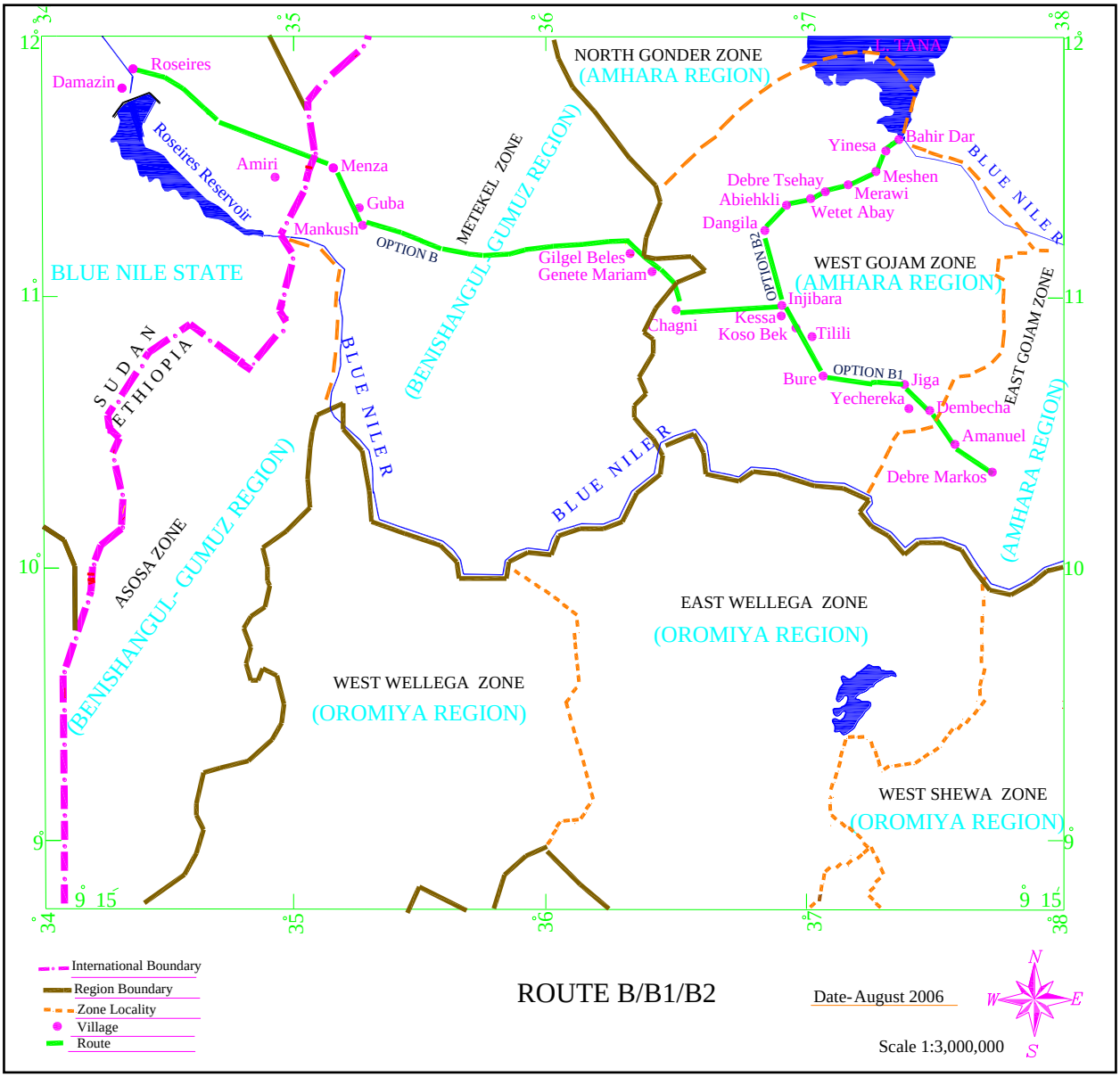

Figure 4. Option B1/B2 route showing administrative areas and villages.

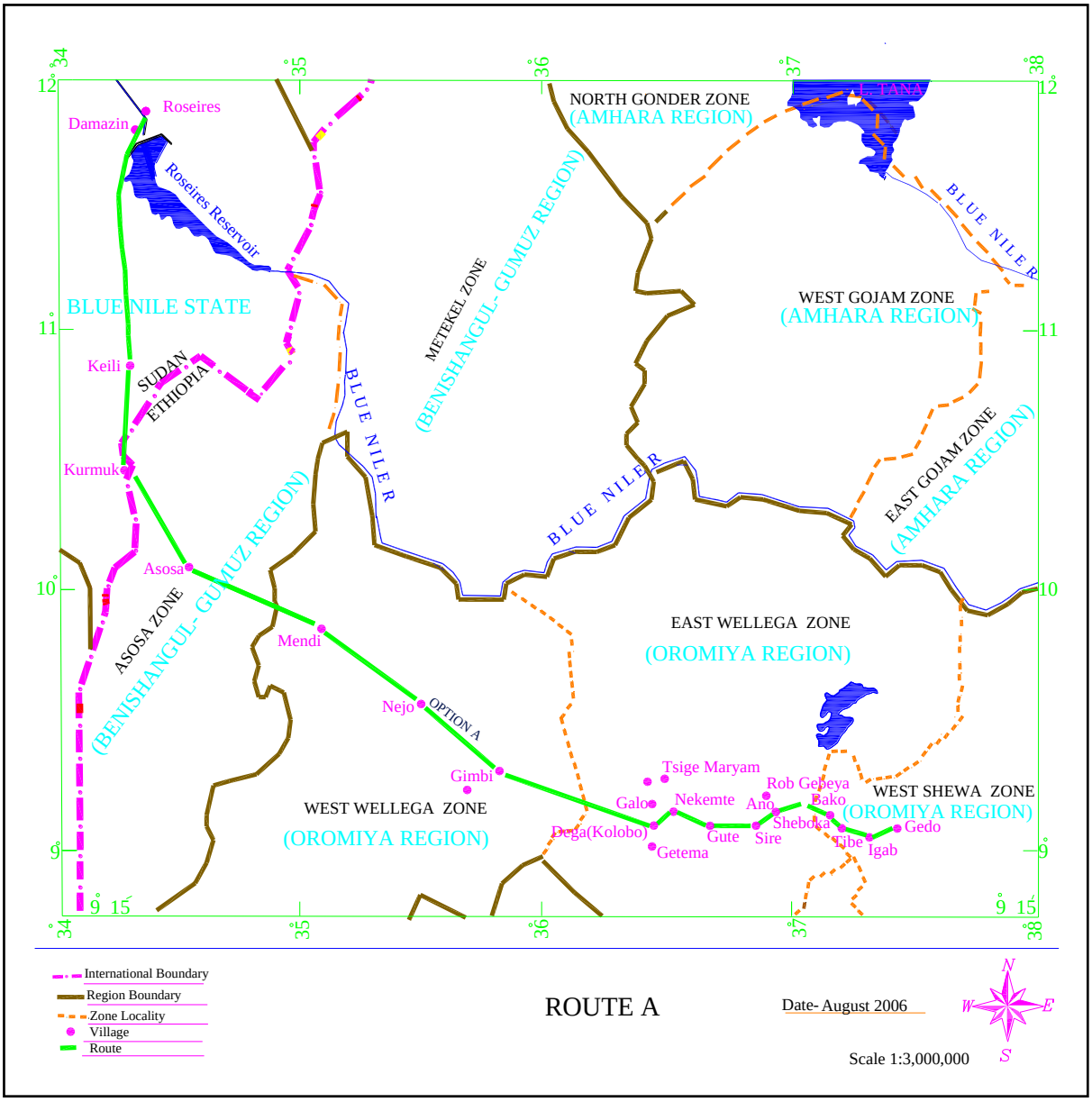

Figure 5. Option A route showing administrative areas and villages.

Photograph 1. The Combretum – Terminalia Woodland near the town of Metema, Option C route (October, 2005).

Photograph 2. Option C Route between Gedaref and Doka showing Savannah Woodland with Acacia shrub understorey on black cracking clay soils (September, 2005).

Photograph 3. The Dry Evergreen Afromontane Forest and a protected Moslem Burial Site between Gonder and Aykel, Option C route (October, 2005).

Photograph 4. Typical wetland in the highlands of the study area, near the village of Tilli, about 150km west of Debre Markos, Ethiopia (Option B route, October 2005).

Photograph 5. Option B Route near the village of Azaza showing grassland/Open Savannah Woodland vegetation on gravely soils found on higher ground (September, 2005).

Photograph 6. Commercially and ecologically important lowland bamboo forest (*Oxytenanthera abyssinica*) south-east of Asosa (Option A route, October 2005).

APPENDIX 5 : List of Workshop Participants

ETHIOPIA-SUDAN POWER SYSTEM INTERCONNECTION ESIA WORKSHOP, NOVEMBER 23, 2005, HILTON HOTEL, ADDIS ABABA

No.	Name	Title	Organization	Telephone no.	Fax no.	E-mail
EGYPT						
1	Dr. Eng. Elham Mohamoud	Undersecretary of state for Research, Planning and International Cooperation	Ministry of Electricity & Energy	202 2639814	202 2616523	eelhamma@yahoo.com
2	Eng. Ivone Fahim	General Management for Network study & interconnection	Ministry of Electricity	202 2616531	202 4011630	
3	Eng. Bothina Abd El Momeim	Director of the Environmental Studies EEHC	Egypian Electricity Holding Company			
ETHIOPIA						
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APPENDIX 6 : Best Practice Environmental Guidelines

ENVIRONMENTAL MANAGEMENT GUIDE

Public Awareness and Community Relations

Objectives	To ensure an awareness of the project exists in the community. To minimise negative impacts and maximise benefits of the proposal on the local community.
Control Measures	The Construction Contractor shall: 1. Advise the local community of project plans in advance of construction, explain safety precautions where necessary and where possible involve them in planning; 2. Avoid disturbances near living areas where possible; 3. Identify culturally sensitive areas and avoid disturbing them; 4. Control runoff and manage sediments especially near privately owned areas; 5. Arrange for local people to be employed and trained; 6. Include women's and other community groups in project activities; and 7. Advise community about approved disposal areas and stockpiles.
Monitoring	The Construction Contractor shall maintain regular contact with the local community to minimize the potential for any problems arising.
Corrective Action	The Construction Contractor shall ensure that the local community has been kept informed about project issues and the above issues resolved prior to commencement of construction works.

ENVIRONMENTAL MANAGEMENT GUIDE

Workforce Training

Objectives	To ensure the construction workforce has a practical understanding of the management measures so that activities are performed in accordance with those measures. To ensure the construction workforce understands the occupational health and safety requirements and that these are implemented at all times.
Control Measures	The Construction Contractor shall implement the following control measures prior to the construction of the works, as indicated below. 1. The Construction Contractor shall organise and conduct induction training for all employed workers covering the following issues: - site hygiene and health issues, in particular nutrition awareness and the sexually transmitted diseases, HIV/AIDS and hepatitis. This instruction will ideally be provided by local community health centres; - gender and other social issues relevant to each community (as identified by the project's Social Scientist and local authorities); - occupational health and safety requirements, including hazard awareness training, materials handling, industrial deafness, industrial diseases such as silicosis etc; and - waste management, including use of garbage bins and toilet facilities. 2. No worker shall be allowed to work on the project unless they have received the above induction training. 3. The Construction Contractor shall keep a written and signed attendance record of all workers who have been inducted. 4. The Construction Contractor shall ensure all occupational health and safety requirements are in place on construction sites and in work camps. 5. The Construction Contractor shall establish a project hazard awareness and hazard reduction plan.
Monitoring	The Construction Contractor shall ensure that all workers have been inducted. The Construction Contractor shall regularly monitor that occupational health and safety requirements are implemented. The Client Representative shall audit that all requirements are met.
Corrective Action	Where occupational health and safety requirements are not being implemented relevant workers shall immediately be trained and instructed to implement these requirements.

ENVIRONMENTAL MANAGEMENT GUIDE

Erosion and Sediment Control

Objectives	To minimise on-site erosion. To prevent off-site sedimentation.

Control Measures	The Designer shall. 1. Ensure pipeline routes do not follow gully lines or drainage paths. 2. Include the requirement for a site rehabilitation plan is included in contract documentation. The Construction Contractor shall implement the following control measures prior to, during and following the construction of the works, as indicated below. 1. Restrict vehicle access onto/from the site to sealed surfaces and designated earth access tracks. 2. Schedule construction so that ground disturbance does not occur during the highest rainfall months. 3. Schedule construction work so that the river intake work is done in a period of minimum flow. 4. Minimise the area of site clearance and ground disturbance by surveying and marking out work sites prior to site disturbance. 5. Instruct workers involved in site clearance and earthworks to restrict construction activities to the marked out sites. 6. Minimise the period of site disturbance by staging site clearance. Do not clear a site before two weeks of the scheduled bulk earthworks. 7. Strip and stockpile all available topsoil as per EMG 5 prior to landforming earthworks. 8. Control runoff onto, through and from the site via stable temporary and/or permanent drains and/or banks installed early in the construction programme. Drains shall collect and convey clean water around the site, and direct on-site runoff into sediment traps.

9. Install sediment controls prior to earthworks, including sediment fences, traps and basins as necessary. Locate controls in order to divide each site into manageable sub-catchments.

10. Clean out sediment fences/traps/basins when 60% or more of the capacity is full.

11. Maintain erosion and sediment controls during the period of soil disturbance and until the site is stable (i.e. equal to or greater than 70% ground cover).

12. Progressively revegetate disturbed areas as soon as construction is completed.

13. Backfill and compact pipeline trenches as soon as possible after pipes have been bedded. Avoid long lengths of exposed trenching.

14. Undertake restoration/revegetation of pipeline routes as soon as pipelines have passed pressure and compliance tests.(see also EMG 4 and 10)

15. Maintain records of locations where excess spoil has been disposed of.

Monitoring	The Construction Contractor shall monitor erosion and sediment controls until the site is stable and the temporary controls are removed. Controls shall be monitored every fortnight and after each significant storm event, to check that they are in place and working effectively, with sufficient sediment trapping capacity available. The Construction Contractor shall retain photographic records of the condition of all the controls.

Corrective Action	If erosion and sediment controls are inadequate, the Construction Contactor shall redesign and install additional controls in accordance with the EMP measures and the Supervising Engineer instructions. If off-site sedimentation occurs, the Construction Contractor shall immediately make good the damage and improve sediment controls by cleaning out existing controls and/or installing additional controls. The Construction Contractor shall then notify the Supervising Engineer, then review the effectiveness of on-site drains and sediment controls.

ENVIRONMENTAL MANAGEMENT GUIDE

Topsoil Removal and Stockpiling

Objectives	To save all available topsoil for reuse in site revegetation. To minimise the decline in topsoil fertility and seed and vegetation viability during stockpiling. To minimise impacts from topsoil stockpiling.
Control Measures	The Construction Contractor shall save all available topsoil for reuse in site revegetation and minimise impacts from topsoil stockpiling by: 1. striping all available topsoil from earthwork sites prior to the commencement of earthworks. If the site is only vegetated with ground cover grasses, grass shall be stripped with the topsoil; 2. stockpiling topsoil on existing cleared sites on flat land and located at least 10 m away from open drains, watercourses and waterbodies; 3. if the stockpile is to remain bare for long in a high rainfall area or during a high rainfall period, it should be covered to prevent erosion and sediment runoff; and 4. installing a sediment fence or low earth bank on the downslope side of the stockpile to retain sediment where a grass filter strip does not exist, or where the site is over 3% grade. The establishment of weeds in topsoil stockpiles shall be managed by engaging members of the local community to hand weed topsoil stockpiles. No herbicides or other chemicals shall be used to control weeds. Where excess topsoil results from the works, topsoil should be used to backfill waste disposal sites.
Monitoring	The Construction Contractor shall inspect topsoil stockpiles after each significant rainfall event to check for erosion and downslope sedimentation.
Corrective Action	If sediment is eroding from stockpiles, the Construction Contractor shall install a sediment fence or earth bank along the downslope toe of the stockpile to retain sediment.

ENVIRONMENTAL MANAGEMENT GUIDE

Air Quality Protection

Objectives	To minimize the deterioration of air quality from project activities.
Control Measures	The Designer shall: 1. Review designs to ensure that structural foot prints are of minimal area 2. Ensure that haul distances between sites/structures are minimised The Construction Contractor shall minimise the deterioration of air quality by: 1. Spraying water on exposed surfaces, including earth access roads and exposed rock surfaces, if conditions are dry and windy work may have to cease as large volumes of dust may be generated; 2. Earth or soil being transported in trucks is to either be covered or wetted to prevent loss during transit. 3. Establish wind speed monitoring: stop all excavation work when wind speed exceeds agreed threshold. 4. Installing wind breaks or fences around cement-batching plants; 5. Ensure all construction machinery used on site is running efficiently and not producing excessive exhaust emissions. 6. Ensure no burning-off of waste is undertaken.
Monitoring	The Construction Contractor shall monitor wind velocity and site dust levels during earthmoving activities. The Construction Contractor shall also monitor emissions from vehicles and plant.

Corrective Action	If excessive dust is generated, the Construction Contractor shall immediately water down areas generating dust or, if this is not effective, cease the activities generating dust. Stop all excavation work if wind threshold velocity has been exceeded.

ENVIRONMENTAL MANAGEMENT GUIDE

Waste Management

Objective	To reuse suitable waste materials generated from the proposed works for productive and non-polluting purposes.
Control Measures	The following measures shall be implemented: 1. All stores waste shall be contained within construction sites; 2. Solid waste: all site waste is to be collected and disposed of in an approved registered landfill. Where possible segregation of waste (paper,glass,metal) should be undertaken and recycling opportunities identified. 3. Compost or use as animal food all green or organic wastes; and 4. Sewage shall be disposed of into sealed pit latrines or into a septic tank system, or other approved sanitation devices.
Monitoring	The Construction Contractor shall regularly monitor the management of wastes to ensure that the above measures are being complied with.
Corrective Action	If it is found that waste is not being managed in accordance with the above measures the situation shall be remedied immediately.

ENVIRONMENTAL MANAGEMENT GUIDE

Noise Control

Objectives	To minimise noise impacts on neighbouring communities.
Control Measures	The Designer shall: 1. Select and specify only equipment that (in addition to satisfying all other technical requirements) minimizes sound output. 2. Incorporate acoustic bafflers in all structures housing noise generating machinery. The Construction Contractor shall minimise construction noise levels and associated impacts by: 1. Undertaking all construction activities strictly within approved hours of operation. Where night-time activities are required, the Construction Contractor shall notify local residents at least three days in advance. 2. Ensuring that all machinery and vehicles used are modern and well maintained, and have mufflers correctly fitted. 3. If generators are used, located them as far as possible from residential dwellings. Where these are near residential dwellings, noise reduction barriers such as soil bunds/stockpiles or sandbags shall be installed to minimise the level of noise emitted.
Monitoring	The Construction Contractor shall monitor noise levels at dwellings closest to the work sites during the range of noise-generating construction activities.
Corrective Action	If local people complain about noise levels or they are deemed to be excessive by the Supervising Engineer, the Construction Contractor shall undertake mitigative measures as directed.

ENVIRONMENTAL MANAGEMENT GUIDE

Site Decommissioning/ Stabilization

Objectives	To clean up work areas so there is no construction debris left at the sites. To facilitate rapid re-establishment of a grass cover over work areas.
Control Measures	The Construction Contractor shall prepare and implement a site rehabilitation/restoration plan for all areas disturbed by the work. The Contractor shall rapidly stabilize sites and provide long-term surface stability by progressively revegetating discrete areas of each work site as they are completed. The sites shall be revegetated by: 1. Raking or loosening any over-compacted ground surface areas identified for vegetation cover; 2. Re-spreading stockpiled topsoil evenly across completed, disturbed sites (including over any permanent fill stockpiles) immediately following construction works. As the vegetation cover of all areas to be stabilised will be grass there will be no need to undertake any planting or weeding. Regular mowing of stabilised areas should ensure that only grasses become established. Sites shall be cleaned-up by: 1. Removing all disabled machinery and construction debris from the works area; and 2. Disposing of any oils in an approved manner.
Monitoring	The Construction Contractor shall visit all work areas following completion of works to ensure that no construction material is left there and to check that topsoil has been re-spread as specified above.
Corrective Action	If any construction debris is found at the work sites this will be removed from site immediately.

ENVIRONMENTAL MANAGEMENT GUIDE

Vegetation Clearance and Protection

Objectives	To restrict vegetation clearance to the minimal area necessary, and thereby prevent damage to vegetation outside the work site. To properly dispose of cleared vegetation.
Control Measures	The Construction Contractor shall restrict vegetation clearance to the minimal area necessary and prevent damage to vegetation outside this area. This shall be achieved by surveying and pegging each work site before the commencement of clearing. Where earthworks are proposed, site clearance shall be staged so that no site is cleared more than two weeks before the earthworks to minimize the time that cleared areas are exposed and vulnerable to soil erosion.
Monitoring	The Construction Contractor shall monitor vegetation clearance daily to ensure that it is restricted to the designated work site/s and that no damage occurs to vegetation outside of works areas.
Corrective Action	If clearance occurs outside the marked area, the Construction Contractor shall notify the Project Manager and facilitate re-vegetation of the cleared area by immediately re-spreading the cleared vegetation over the area.

ENVIRONMENTAL MANAGEMENT GUIDE

Excess Fill Disposal

Objectives	To utilize excess fill material for productive purposes where possible, and thereby avoid the double handling of material. To minimize environmental impacts from fill disposal. To prevent the creation of obstacles or the future removal of disposed fill to install other developments.
Control Measures	The Construction Contractor shall: 1. Dispose of excess fill in approved areas. Sites shall generally be at least 10 m from watercourses, not excessively steep (i.e. usually less than 10% grade) and free of trees and any other significant vegetation. 2. Mark the boundary of the fill disposal site with pegs at 10m intervals. 3. Install erosion and sediment controls as required. 4. Clear vegetation and strip topsoil off the disposal site and stockpile as per EMG 4 for reuse for site revegetation. 5. Landform the fill by placing it in horizontal layers with a maximum depth of 200mm, then compacting each layer to the degree required for the proposed land use, as directed by the Supervising Engineer, creating a free draining profile. 6. Revegetate the filled landform by ripping the final compacted layer of fill to a depth of 150-300mm along the contour to create a slightly roughened surface and re-spread stockpiled topsoil.
Monitoring	The Construction Contractor shall monitor the fill disposal activities to ensure that the specified process is correctly followed.
Corrective Action	If the Construction Contractor discovers that the above process has not been properly followed actions will be taken to ensure that fill disposal is in accordance with the specified process.