

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT FOR LOWAAT DAM PROJECT

Prepared For:
NATIONAL IRRIGATIONAL BOARD

Report prepared by



CONSULTANT

This Environmental and Social Impact Assessment Project Report for the Lowaat Dam project to be located in Lokori Location, Lokori Division in Turkana East Sub-county was prepared in accordance with the provisions under the Environmental Management and Coordination Act, 1999 and the Environmental Impact Assessment and Audit Regulations, 2003, for submission to the National Environmental Management Authority (NEMA). I, the undersigned, hereby approve that this report contains fair disclosure from the proponent, views of stakeholders and recommendations to be undertaken by the proponent.

Mr. Elvin Oeri Nyagaka

.....
NEMA Registered Lead EIA/EA Expert. No: 7069

PROPONENT

I, on behalf of the National Irrigation Board, i submit this Environmental and Social Impact Assessment Project Report for the proposed Lowaat Dam project to be located in Lokori Location, Lokori Division in Turkana East Sub-county. To my knowledge all information contained in this report is accurate and a truthful representation of the findings as relating to the project.

Signature

Date

Designation

LOWAAT DAM DEVELOPMENT PROJECT ENVIRONMENTAL AND SOCIAL

(ESIA) IMPACT ASSESSMENT PROJECT REPORT CONTENTS

1.	INTRODUCTION.....	11
1.1	BACKGROUND	11
1.2	Hydrology	13
	Kerio Catchment.....	13
1.3	PURPOSE OF THE EIA.....	13
1.4	SCOPE OF THE EIA STUDY.....	13
1.5	METHODOLOGICAL AND APPROACH	14
1.6	STAKEHOLDER CONSULTATIONS.....	15
1.7	EIA TEAM OF EXPERTS.....	17
2.	POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK.....	18
2.1	INTRODUCTION	18
2.2	Relevant policies.....	18
	2.2.1. Irrigation policy	18
3.	PROJECT REPORT	23
4.	ENVIRONMENTAL IMPACT ASSESSMENT STUDY	24
4.1	Key legislations related to the Environment.....	24
	Environmental Management and Coordination Act, 1999	24
4.2	Regulations	31
4.3	Relevant institutions	32
5.	PROJECT DESCRIPTION	35
5.1	PROJECT DETAILS.....	35
5.2	NATURE OF THE PROJECT.....	37
5.3	INPUT RAW MATERIALS	37
5.4	PROJECT JUSTIFICATION.....	38

5.5	PROJECT ALTERNATIVES	38
6.	DESCRIPTION OF EXISTING ENVIRONMENT	40
6.1	INTRODUCTION	40
6.2	PHYSICAL ENVIRONMENT	40
6.3	SOCIO-ECONOMIC ENVIRONMENT	41
7.	POTENTIAL ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS	42
7.1	GENERAL CONSIDERATIONS.....	42
7.2	PREDICTION OF IMPACTS.....	43
7.3	IMPACT CLASSIFICATION AND CRITERION	43
7.4	POSSIBLE ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS.....	45
7.5	Dam wall and spillway construction	47
7.6	EQUIPMENT MOBILISATION AND OPERATION	48
7.7	Construction Stage	49
7.8	Operation Stage.....	49
7.9	BORROW PIT OPERATION, MATERIALS HANDLING AND REHABILITATION	50
8.	MITIGATION AND ENHANCEMENT MEASURES.....	62
9.	Environmental and Social Monitoring	64
9.1	Internal monitoring	64
9.2	External monitoring and evaluation	65
10.	CONCLUSION AND RECOMMENDATIONS	71
	Conclusions	71
	Recommendation.....	71

List of Tables

Table	Description	Page
Table 1.1.	EIA Team members	17
Table 6.2:	Population of the project area in 2009.....	41
Table 7.1.	general impacts associated with dam construction	44
Table 8.1.	Summary of mitigation and enhancement measures	62
Table 9.1.	Brief environmental management plan.....	66
Table 9.2.	Cont. brief environmental management plan	67
Table 9.3.	Cont. brief environmental management plan	68
Table 9.4.	Cont. brief environment management plan	69
Table 9.5.	Cont. brief environmental management plan	70

List of Figures

Figure	Description	Page
Figure 1.1	Map showing Kerio Catchment Area	12
Figure 2.1	schematic presentation of the current EIA process in Kenya.....	22

ABBREVIATIONS AND ACRONOMYS

%	: Percentage
ASAL	: Arid and Semi-Arid Land
(CBD)	: Convention on Biological Diversity
°C	: Degrees Celsius
EA	: Environmental Audit
EIA	: Environmental Impact Assessment
EMCA	: Environmental Management Coordination Act
EMP	: Environmental Management Plan
HEP	: Hydro Electric Power
ID	: Identity
IEA	: Initial Environmental Audit
KENGEN	: Kenya Energy Generating
Company Km	: Kilometres
Km ²	: Square Kilometers
Ksh	: Kenya Shillings
m	: Metres
M.a.l.s	: Meters above sea level
Mg/l	: Milligram per
Litre ml	: Milliliters
mm	: Milliliters
NEAP	: National Environment Action Plan
NEC	: National Environment Council
NEMA	: National Environment Management Authority
NIB	: National Irrigation Board
No	: Number
OHSO	: Occupational Health and Safety Office
PM	: Particulate Matter
PPE	: Personal Protective Equipment
PVC	: Polyvinyl Chloride
RPM	: Respiratory Particulate Matter
SHE	: Safety, Health and Environment
TOR	: Terms of Reference
WRMA	: Water Resources Management Authority

BACKGROUND

This report is an Environmental and Social Impact Assessment (EIA) report for the proposed Lowaat Dam project to be located in Lokori Location, Lokori Division in Turkana East Sub-county.

Kerio River rises on the Northern slopes of the Asmaya Hills to the West of Lake Bogoria. It flows Northward through the Kerio Valley between Tugen Hills and Elgeyo Escarpment. The Elgeyo Escarpment rises to over 1830 meters (6000 ft.) above the Kerio Valley in some places. The Kerio River continues Northward, often through deep and narrow valleys, to enter Lake Turkana in a delta just South of the deltas formed by Turkwel and Lokichar Rivers.

Three irrigation schemes currently exist in Turkana East Sub-county within the lower reaches of Kerio River. These are Morulem, Lokubae and Elelea. Within these lower reaches, Kerio River is seasonal and has no water between the months of January and March. This has limited the development of irrigation in the area despite the availability of suitable soils for agriculture.

The Environmental Impact Assessment (EIA) was undertaken to determine, analyse and present the environmental impacts of proposed Dam Project, formulate remedial measures to mitigate the negative impacts and plan in such a way that a rational decision can be made about its implementation. The EIA multi-disciplinary team studied the project sites and their conditions, assessing the needs for design adjustments taking into account existing infrastructure. The methodology used involved six basic steps:

- Review of the literature on environmental baseline conditions of the project area and its immediate environs relating to past studies;
- Scoping exercise aimed establishing issues of relevance to the study;
- Consultative meetings with stakeholders at various levels in order to determine the potentially significant issues of the project and to exclude any issues unlikely to be of significance;
- Identification and analysis of the magnitude and significance of the principal impacts;
- Determination of appropriate mitigation measures and/or design changes to eliminate or reduce the identified impacts; and
- Formulation of an environmental management plan and monitoring plan, the emergency response Plan as well as dam decommissioning plan.

In undertaking the EIA, relevant legal instruments were reviewed focusing on provisions relevant to the proposed dam project.

PROJECT JUSTIFICATION AND OBJECTIVE

Kenya as a country faces frequent food shortages and insecurity. Over reliance on rain-fed agriculture has been identified to be responsible for this situation. In order to overcome the food shortages and insecurity, the Government through National Irrigation Board intends to carry out the following:

- Rehabilitate and extend large scale irrigation schemes;
- Develop new schemes through optimum utilisation of available resources; and
- Develop water storage facilities so as to harness excess rain water thereby reducing negative impacts related to floods.

The area under irrigation and drainage in Kenya is expected to increase to 1.2 million ha in 2030 through expansion of irrigation acreage by 48,000 ha per year. This calls for accelerated development of irrigation and drainage infrastructure.

PROJECT ALTERNATIVES

The design of Rock fills and earth dams has to ensure that a safe and economical structure is constructed. In this regard, the following considerations are pertinent:

- The slopes of the embankment must be stable under all conditions of construction and operation, including rapid drawdown of the reservoir.
- The embankment wall and the water in the reservoir must not overstress the foundation.
- The foundation under the reservoir area must be water tight. In the event of fissures, the pressure grouting must be done.

IMPACTS AND MITIGATION MEASURES

- i. The dam is likely to act as a tourist attraction both at the local and Regional levels considering the aesthetic land scape and act as a learning resource for institutions; additionally, the proposed resort will also help boost tourism;
- ii. There will be creation of job opportunities for skilled or unskilled persons either directly or indirectly from within and outside the community. They will include; consultants and the contractors;
- iii. The project will pay for permits, licenses and relevant taxes to the county and National government;
- iv. Lowaat dam will provide reliable water supply for domestic use the residents of Lokori, Lochakula and Katilia Locations within Lokori Division, Turkana East Sub-county.
- v. Lowaat dam will produce electricity for Lokori Town and its environs. Power demand for Lokori Town is estimated to be 20 MW;
- vi. The dam will Enhance fish farming;
- vii. The storage and abstraction of water for irrigation would enhance commercial agriculture especially the cultivation of horticultural crops;
- viii. Increased food production in the project area would likely enhance food security and better nutrition in the community;

- ix. The availability of adequate and nutritious food would health of the community
- x. Electric power generation is one of the main components of the project and it is estimated that 20Mw shall be generated by 2 independent units of 10mw each
- xi. Loss of social & cultural infrastructure: No social or cultural infrastructure will be inundated and therefore no mitigation is required.
- xii. Economic growth: Ensured effective management of the irrigation scheme
- xiii. Increase in local population: Give priority for employment to local people
- xiv. Increase in local economic activities: Ensure that the irrigation scheme is operated in a professional manner
- xv. The dam will be useful for fish production and therefore increasing the availability of protein and increasing economic benefits upon sale of the same
- xvi. Loss of productive land, historical and cultural sites: No mitigation is required for loss of historical and cultural sites since none are located within the impoundment area. However, the developer will take a precautionary measure i.e. should any effect of historical nature be discovered during construction, relevant authorities will be notified immediately.
- xvii. Loss of wildlife habitat, flora and fauna: limit clearance of vegetation only to critical areas, Conduct awareness campaigns among staff and community on the need to conserve nature and Adopt strict good practices in conservation
- xviii. Erosion of the top soil and reservoir sedimentation: Carryout reforestation of the disturbed area after construction activities using guidelines given in annex 10, Limit movement of heavy machinery only to designated access routes and operational areas
- xix. Skills Transfer to local people: Ensure there is skill transfer through an elabora programme, Categorise staff and each group to be supervised by dedicated skilled personnel to ensure on job training and encourage job on training through observation and trial under supervision
- xx. Pollution due to increased usage of pesticides and fertilisers: Stick to recommended dosage and frequency of application of agro chemicals, ensure recommended types of agro-chemicals are used and conduct awareness campaign among communities on dangers of agro chemicals.
- xxi. Deterioration in water quality: Stick to good practices of dam operation rules of ensuring minimum flows in times of low flow and Ensure prior clearance of all deadwood/vegetation prior to dam filling
- xxii. Change in water quantity in downstream: Ensure that the design has adequate design provisions to allow flow downstream even in times of dry months, Apply standard dam operational rules and Observe water right permit regulations and requirements for the sake of downstream water right holders
- xxiii. Encroachment of aquatic weeds: Create a buffer zone between the waterfront and settlement area, avoid discharge of any waste effluent into the dam and conduct awareness on invasive aliens aquatic weeds
- xxiv. Deterioration of public health: Encourage natural aquatic life that takes care of mosquito larva as part of the food chain
- xxv. To dust pollution: Undertake watering of the area and surroundings regularly during construction stage
- xxvi. Loss of wildlife habitat, indigenous flora and fauna: encourage natural restocking of the area by educating the locals on the benefits of conserving nature; discourage cutting of trees and unnecessary clearing of vegetation within the area.
- xxvii. Erosion of the top soil: limit use of heavy machinery to designated areas, avoid unnecessary clearing of the vegetation and rehabilitate heavily disturbed areas.
- xxviii. Reservoir sedimentation: Ensure a buffer zone is created between the water front and occupied areas of human settlement and agricultural activities, avoid unnecessary clearing of the vegetation

- xxix. Soil and water pollution due to oil spills: Ensure all machinery and equipment is regularly maintained, limit servicing and repair of machinery and equipment to designated areas and dispose any used oil at in accordance with the law
- xxx. Skills transfer to locals: Adopt a deliberate policy of giving employment priority to locals, design on job training programmes and ensure skilled manpower is employed
- xxxi. Erosion of the top soil and reservoir sedimentation: Restrict movement of vehicles and equipment to designated areas and Restrict clearance of vegetation to critical areas
- xxxii. Deterioration in water quality in downstream reaches of the stream: Observe standard dam operation rules and ensure minimum flows downstream at all times
- xxxiii. Change in water quantity in downstream reaches of the stream: Ensure that excess flow during summer season is harnessed and Observe Water Right regulatory requirements
- xxxiv. Encroachment of aquatic weeds and water quality of the reservoirs: Conduct awareness campaigns among the staff and community on the dangers of invasive aquatic weeds, Promote sustainable fishing methods and Minimise nutrient loading through effective usage of agro chemicals
- xxxv. Deterioration in groundwater quality: Remove most of the vegetation from the area prior to dam filling to reduce decaying of organic matter and regulate use of agro chemicals to maintain water quality in the reservoir
- xxxvi. Pollution due to solid waste: Collect waste at selected points for proper disposal at a designated area and some of the rubble will be used for compaction in the construction of the dam wall
- xxxvii. Deterioration in water quality due to liquid waste: Provide portable sanitation facilities for construction workers.

ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

A monitoring and environmental management plan (EMP) has been elaborated for purposes of addressing identified adverse/positive impacts. Under the EMP, various mitigation measures have been organized into well-formulated plan, which will serve as a guide for construction and operation phases of the proposed project.

CONCLUSION

Any meaningful developmental project of magnitude such as Lowaat Dam Project comes at a cost either economically or socially and can hardly ever be without either positive or negative impacts. However, what is important is to systematically identify all potential impacts and put measures in place aimed at either enhancing benefits or minimising impacts through an elaborated Environmental Management Plan. It is for this reason that as developers of this project we believe that natural resources such as water can sustainably be utilised to optimise on the benefits for the good of all. Construction of water retaining structures such as dams, is one such initiative aimed at attaining these benefits and thus require support from all especially in light of scanty rains and unreliable rainfall pattern.

1. INTRODUCTION

1.1 BACKGROUND

Turkana County is within the ASAL areas of the country with very little rainfall that cannot sustain any meaningful agriculture. The people in these areas have been depending mainly on Livestock and partly rainfed irrigation which has not been very successful due to the erratic nature of rainfall. This has been resulting in very little food production thereby threatening the food security situation and often calling for relief food supplies.

The project endowed with perennial river River Kerio which drains most of the Turkana area before finally draining into to Lake Turkana. However, there are a number of feeder seasonal rivers which swell considerably during the rainy periods thereby increasing the flows along River Kerio with the consequence of flooding and inundation of farm lands. The floods within this region cause disasters which interrupt the normal ways of life of the local people. While responding to the disasters, the government is often assisted by other development partner.

In order to avert the drought situations prevalent in these areas as well, the National Irrigation Board has proposed to construct Lowaat Multipurpose Dam Project which would harness runoff during the rains and then release the waters for various uses among them water supply and irrigation. As a way of increasing the economic viability of the dam, the waters from the reservoir will also be used for generating hydropower, fish farming and a resort will be set up. There is also the unquantifiable benefit of mitigating floods in the lower reaches of the river.

In order to meet the above objectives, a dam axis joining Lowaat Hills was confirmed. The length of the dam crest is 480m.

This Environmental Impact Assessment (EIA) project report has therefore been prepared in compliance with Part VI Section 58 of the Environmental Management and Coordination Act. 1999 No. 8, The EIA project report is structured in accordance with NEMA guidelines. Below is the report structure:-

- i) Executive Summary;
- ii) Introduction of the Project and the Developer;
- iii) Policy Legal and Administrative framework;
- iv) Project Description;
- v) Existing Biophysical and Social Economic Environment ;
- vi) Potential Environmental and Social Impacts;
- vii) Proposed Enhancement and Mitigation measures ;
- viii) Environmental Management Plan;
- ix) Environmental Monitoring Plan;
- x) Decommissioning Plan;
- xi) Review of Engineering Designs; and
- xii) Annexes.

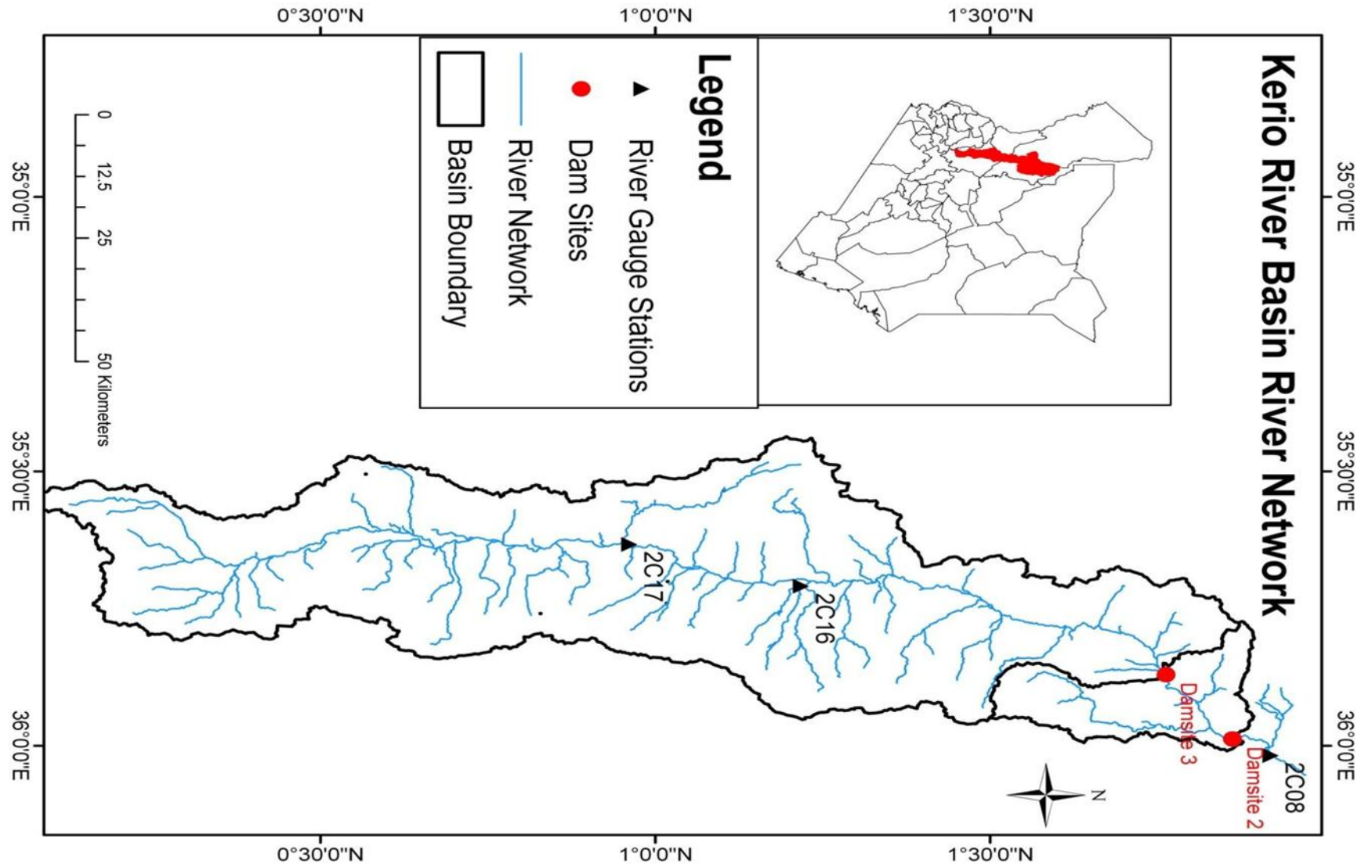


Figure 1.1 Map showing Kerio Catchment Area

1.2 Hydrology

Kerio Catchment

The section of the Kerio catchment contributing to the proposed dam sites is bounded by geographic coordinates 35.43°E and 36.071°E and 0.0096°N and 1.98°N. The basin elevation falls from 3525 m.a.s.l in Timboroa to around 640 m.a.s.l in Lokori Town. The basin strides the Rift valley from Timboroa to Lake Turkana.

Kerio River has a length of 220 km long as it flows downstream. Numerous tributaries join the river as it flows downstream. Figure 2-2 presents the Digital Elevation Model (DEM) for Kerio River catchment.

1.3 PURPOSE OF THE EIA

Under Part VI Section 58 of the Environmental Management and Coordination Act 1999 No. 8, any person, being a proponent of a project is required to apply for and obtain an Environmental Impact Assessment (EIA) license from National Environment Management Authority (NEMA) before he/she can finance, commence, proceed with, carry out, execute, or conduct any undertaking specified in the 2nd Schedule of the Act. The National Irrigation Board therefore, undertook this environmental and social impact assessment for the proposed Lowaat dam Irrigation Development project in order to comply with this requirement, and has led to the production of this Environmental and social Impact Assessment Project Report for purposes of obtaining an EIA License.

1.4 SCOPE OF THE EIA STUDY

Dam project environmentally The EIA study comprised, but not limited to a scoping meeting, stakeholder consultations and detailed specialised field investigations as outlined below;

- Undertake a Scoping Exercise

The scoping exercise was intended to identify and screen all relevant issues related to the proposed project as well as to identify at the earliest possible time whether any detrimental effects existed that could render the unacceptable. Arising out of the scoping exercise was a number of issues.

- Existing Baseline Environmental Conditions

Primary data on environmental and socio-economic baseline conditions for the project within the project areas was collected during field surveys and analysed. Further an analysis of available secondary data from past studies .

➤ Description of Project Activities

Construction of a dam involves use of various construction materials and equipment. Thus project inputs, activities and outputs during project preparation, construction and operational life stages are described. This section also include description of project alternatives

➤ Possible Mitigating Measures Formulation

A number of measures and plans for mitigating the identified possible adverse environmental impacts of the earth dam project have been proposed including measures and plans for enhancing positive environmental impacts. And wherever possible, the costs and benefits of these environmental measures are quantified.

➤ Environmental Management and Monitoring Plan

A management and monitoring plan for implementing cited mitigation measures during preparation and construction phases as well as operational life of the Lowaat Dam Project is elaborated. The plan further indicates management responsibilities and time frames.

➤ Elaboration of a Decommissioning Plan

A decommissioning plan elaborates measures to be taken in an event of decommissioning the dam. This is aimed at ensuring that the environmental conditions are managed and if possible restored for sustainability of the ecosystem.

1.5 METHODOLOGICAL AND APROACH

The EIA multi-disciplinary team studied the project sites and their conditions, assessing the needs for design adjustments taking into account existing infrastructure. The team also studied and reviewed existing literature.

Several field surveys couple with consultative meetings in the area were undertaken to assess the different aspects of the project and the environment. The methodology used for this assessment was standard and involved six basic steps:

- Review of the literature on environmental baseline conditions of the project area and its immediate environs;
- Scoping exercise aimed establishing issues of relevance to the study
- Consultative meetings with stakeholders at various levels in order to determine the potentially significant issues of the project and to exclude any issues unlikely to be of significance;
- Identification and analysis of the magnitude and significance of the principal impacts;
- Determination of appropriate mitigation measures and/or design changes to eliminate or reduce the identified impacts; and
- Formulation of an environmental management plan and monitoring plan, the emergency response Plan as well as dam decommissioning plan.

1.6 STAKEHOLDER CONSULTATIONS

Transparency and open consultative process are an important element of any EIA process that ensures that public views are taken into account in determining the scope of the EIA study. In recognition of this important aspect, a public consultative workshop was held at Terter resort Resort Hotel in Lokori . The meeting was attended by relevant stakeholders including government departments as well as other interested and affected parties. Details of the proceedings for the consultative meeting are elaborated below

1.1.1 Approach and Methodology

The stakeholder consultation process involved stakeholder meetings and open discussions. The aim was to get views from stakeholders in terms of how they understood the dynamics of the environment in which the proposed project will be located and any possible underlying causes that could lead to changes over time as a result of implementing the project.

Consultations with stakeholders having either experience or expert knowledge on the study area were also conducted to validate existing data as well as get their advice on any additional sources of information that was not readily available. The objective was to obtain their interpretation with regard to the underlying factors of the trends already observed. Those located within or around the project area were visited as well where it was deemed that they are likely to shed very useful pieces of information.

Responses from the stakeholder workshop provided the relevant background information and helped identify major environmental concerns of the stakeholders within the project area.

1.1.2 Outcome of the consultative process

Below is a concretized list of pertinent issues that were raised during the consultative process; Generally most stakeholders welcomed the idea of constructing Lowaat dam. The need to take into account future water requirements of other stakeholders. The possibility of partnering up with other stakeholders in the area in the utilisation of the water from the proposed dam.

Positive impacts raised by different groups

- i. One member felt that the project could attract tourists in the area;
- ii. Another one stated that thought that the project is likely to increase crop yields;
- iii. A good number of people in the meeting observed that there is a likelihood that livestock keeping will increase.
- iv. A farmer from Katilia said that the project is likely to increase the value of land and more investors will come to the project area;
- v. it was stated that the project could bring foreign exchange to the area whereas increased family income and there are could a lot of food security;
- vi. Mr. Protus believed that the project could create job opportunity to jobless youths and reduce banditry rates in the area;
- vii. it was suggested that the project could lead to improved infrastructure in the region .
- viii. many bsakeholders believed that the project is likely to bring fish farming in the project area.

Negative impacts

- i. It was said that the project could lead to many cases of suicide especially near the dam site. Additionally, he asserted that the project could result to water related diseases such as Malaria and Bilharzia
- ii. Stakeholders thought that the reduce water quality for the downstream users.

Questions/ Discussions

The area MCA wanted to seek clarification as to whether the dam could develop future problems such as breakages and this poses a lot of risk in case of an eventuality many lives and properties would be lost.

In response, the consultant stated that during the bidding of contracts, there are many factors that are considered in giving the tender. This applies to Lowaat development project where due process was followed. Additionally, Design Master Plan is a firm that has qualified team of engineers who have worked on many successful projects and there was no doubt that the dam could last many decades.

One village elder expressed concerns over the ownership of the dam development project and if the locals could have a say to the project.

1.7 EIA TEAM OF EXPERTS

Names of persons involved in the compilation of the environmental impact Assessment for the Lowaat Dam Project are given below.

Table 1.1.EIA Team members

ITEM	NAME OF TEAM MEMBER
1	Eng. Stephene Oloo (Team Leader)
2	Mr. Elvin Oeri Nyagaka (Lead Expert)
3	Mr. Dennis Ndiema (Irrigation Engineer)
4	Mr. Donald Ndiema (Dam specialist)
4	Mr. Japheth Khisa (Associate Expert)
5	Patrick Odindo (Socialologist)

2. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 INTRODUCTION

This chapter reviews and analyzes the relevant policies, laws, regulations and institutions that affect the implementation of the proposed Lowat dam. The policies in question include; the irrigation policy, water policy and the environment policy. The key legislations considered include the EMCA, 1999; water Act, 2002, Agriculture Act Cap 318, The Forest Act, 2005, among others. The regulations reviewed include; the environmental impact assessment and Audit, water quality, conservation of biological diversity and the water resources management rules, 2007. The international Conventions and Treaties reviewed include; the Ramsar Convention and the Convention on Biological Diversity. The proposed irrigation project shall adhere to the relevant policies and laws that govern environmental management matters in Kenya.

2.2 Relevant policies

2.2.1. Irrigation policy

The following are sections of the irrigation policy.

5.4.18 Irrigation using treated waste water and the recycling of irrigation tail waters, including use of low quality water, will be supported so long as there will be no adverse effects on human, crop, livestock and ecosystem health, as certified by the relevant authorities.

5.4.19 Development of irrigation shall comply with environmental protection requirements to ensure ecosystem integrity, agro bio-diversity and environmental conservation. All new and continuing developments will be subjected to Environmental Impact Assessment and Environmental Audits in line with the relevant regulatory statutes.

5.4.20 Development of irrigation shall institute measures to reduce the incidence of water-borne and water-related diseases, and take consideration of public health issues. Public health, sanitation and safety, including mitigation measures such as vaccination, flood control, pest control, and preventative measures for healthy livelihoods and environments will be upheld in irrigated agriculture.

5.4.21 Irrigation programmes shall observe prevention and control of water pollution by ensuring compliance with the legal and sanitary conditions set by relevant regulatory authorities, and promote safe use of agrochemicals and water.

5.4.22 The discharge of sewerage, industrial effluents and other pollutants will be prohibited in irrigated areas and the Government, through its agents, will conduct regular assessments and monitoring of environmental damage caused by irrigation with a view to introducing the requisite remedial measures and/or stopping irrigation activities. Further,

pollution control in irrigation shall adopt the 'Polluter-Pays' principle in order to ensure water user responsibility.

5.4.23 All irrigation developments will undertake assessments for salinity of the soil profile and irrigation waters and be certified by relevant authorized agency. Irrigation on land having salinity problems and/or with water that contains appreciable amounts of salts/minerals will be permitted only after certification by the relevant authority, for specified crops and/or management systems, and where there are no long-term adverse effects on-site or off-site.

5.4.24 Conservation of catchment areas and water sources will be upheld. The development of irrigation will be supportive of forestry and agroforestry practices, within and beyond the irrigation command areas, and will uphold the silvicultural measures in line with Government policies and laws in promoting forestry and agroforestry.

5.4.25 The Government will continue to play a regulatory role in the sector, to protect the sector against harmful emerging products and technologies, and to facilitate testing and safety control before new products and technologies are released to the public.

5.4.26 The Government, in collaboration with professionals and key stakeholders, will advocate for irrigation as an important coping and adaptation strategy against climate change and its impacts. Appropriate measures which are adaptable by farmers will be identified and strategies implemented for climate change preparedness and mitigation. Efforts by public and private sector 35 National Irrigation and Drainage Policy organizations to address climate change will be supported and capacity built among communities, training and research institutions, and key stakeholders.

The proposed irrigation project shall endeavor to adhere to the irrigation policy during the implementation and operation stages.

2.2.2. Vision 2030

Kenya Vision 2030 is the country's new development blueprint covering the period 2008 to 2030. It aims to transform Kenya into a newly industrializing, "middle-income country providing a high quality life to all its citizens by the year 2030".

The Vision 2030 is founded on economic, social and political pillars anchored on macroeconomic stability; continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure; energy; science, technology and innovation (STI); land reform; human resources development; security as well as public sector reforms. Vision 4 of the paper is adding value to products and services. Under this vision, the country envisions raising incomes in agriculture, livestock and fisheries. The strategy proposes processing and adding value to her products before they reach the market. This is to be accomplished through an innovative, commercially oriented and modern agriculture, livestock and fisheries sector.

These interventions are expected to generate an additional KSh.80-90 billion increase in GDP, mainly through better yields in key crops, increased smallholder specialization in the cash crop sector (2-3 crops per plot), utilization of a million hectares of currently uncultivated land, and new cultivation of up to 1.2 million hectares of newly-opened lands. Specific strategies are to transform key institutions in agriculture and livestock to promote household and private sector agricultural growth and increase productivity of crops and livestock. The Vision recognizes that Kenya is a water scarce country. The economic and social developments anticipated by Vision 2030 will require more high quality water supplies than at present.

The strategy therefore, proposes water conservation and starting of new ways of harvesting and using rain and underground water.

The goal of the vision for 2012 is to promote agricultural productivity and increase area under irrigation and drainage from 140,000 to 300,000 hectares. Specific projects to achieve this vision include constructing multi-purpose dams with storage capacity of 2.4 billion m³. This project will therefore contribute to the overall achievement of the different sectors of the vision 2030.

2.2.3. Water policy

The Ministry of Water Resources in 1999, the precursor of the Ministry of Water & Irrigation developed a Water Policy Paper with the aim of providing an elaborate and efficient mechanism for the development of water resources and water use. This is known as the Sessional Paper Number 1 of 1999 on National Policy on Water Resources Management and Development.

The Policy Paper set out to tackle issues pertaining to Water Resources Management, Water and Sewerage Development, Institutional Framework and Financing of the Water sector. It necessitated the overhauling of the existing Water Act (Cap 372) to the current Water Act 2002, which established the water provision and service institutions as they exist today.

The Policy Paper stipulates that, the long-term objective of the Government of Kenya is to ensure that all residents in the country are entitled to clean and potable water by protecting the water resources:

Section 2.6.2 proposes that the water abstraction and disposal permits be dynamic and economic instruments for the water quality control.

Section 2.6.3, states that 'a process of water quality monitoring of all water bodies and pollution control inspection of existing and potential polluting sources will be put in place.

Section 2.7.1, the policy paper stresses that there should be continuous water resources assessments for the determination of sources, extent, dependability and quality of water resources and further states that, monitoring of water quality parameters provides baseline data for the purpose of pollution control.

Section 2.7.4 calls for the establishment of fully fledged hydrologic, hydrogeologic, water quality, water permits and socio-economic databases at all water resources management levels for the purpose of establishing comprehensive water resources databases.

Section 3.3.1 mandates the Ministry of Water & Irrigation to facilitate formulation of policy framework to guide water sector activities.

The proposed irrigation project shall adhere to the water policy requirements to ensure sustainable utilization of the same

2.2.4. Environmental policy

The Kenya Government's environmental policy is geared towards sound environmental management for sustainable development. The Kenya Government's environmental policy aims at integrating environmental aspects into national development plans. The broad objectives of the national environmental policy include:

Optimal use of natural land and water resources in improving the quality of human environment;

Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations;

Integration of environmental conservation and economic activities into the process of sustainable development; and

Meeting national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth.

At present there are over twenty (20) institutions and departments which deal with environmental issues in Kenya. Some of the key institutions include the National Environmental Council (NEC), National Environmental Management Authority (NEMA), the Forestry Department, Kenya Wildlife Services (KWS) and others. There are also local and international NGOs involved in environmental issues in the country. The object and purpose for which NEMA is established is to exercise general supervision and co-ordinate over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment.

NEMA mandate is designated to the several committees including the County Environment Committees in respect of every County. They are responsible for the proper management of the environment within the County in respect of which they are appointed. The decisions of these committees are legal and it is an offence not to implement them.

2.2.5. The Environmental Impact Assessment process in Kenya.

It is a condition of the Kenya Government for project proponents to conduct Environmental Impact Assessment on development Projects. According to Sections 58 and 138 of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 and Section 3 of the Environmental (Impact Assessment and Audit)

Regulations 2003 (Legal No. 101), projects in the second schedule of the Act require an Environmental Impact Assessment project/study report prepared and submitted to the National Environment Management Authority (NEMA) for review and eventual licensing before commencement. This was necessary to maintain sustainable development without damaging the environment.

In applying for an Environmental Impact Assessment License, the proponent has to first submit at least 5 copies of the Project Report, duly filled Form 1 and the prescribed EIA processing and license fees in form of a banker's cheque in favor of NEMA as per Regulation 6 of the Environmental (Impact Assessment and Audit) Regulations, 2003.

However, according to Regulation 10 (3) of the Environmental (Impact Assessment and Audit) Regulations, 2003, if NEMA finds that the Project will have a significant impact on the environment, and a Project Report discloses no sufficient mitigation measures, NEMA shall require that the Proponent undertake a full Environmental Impact Assessment Study in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003.

Figure 2.1 overleaf is a schematic presentation of the current EIA process in Kenya.

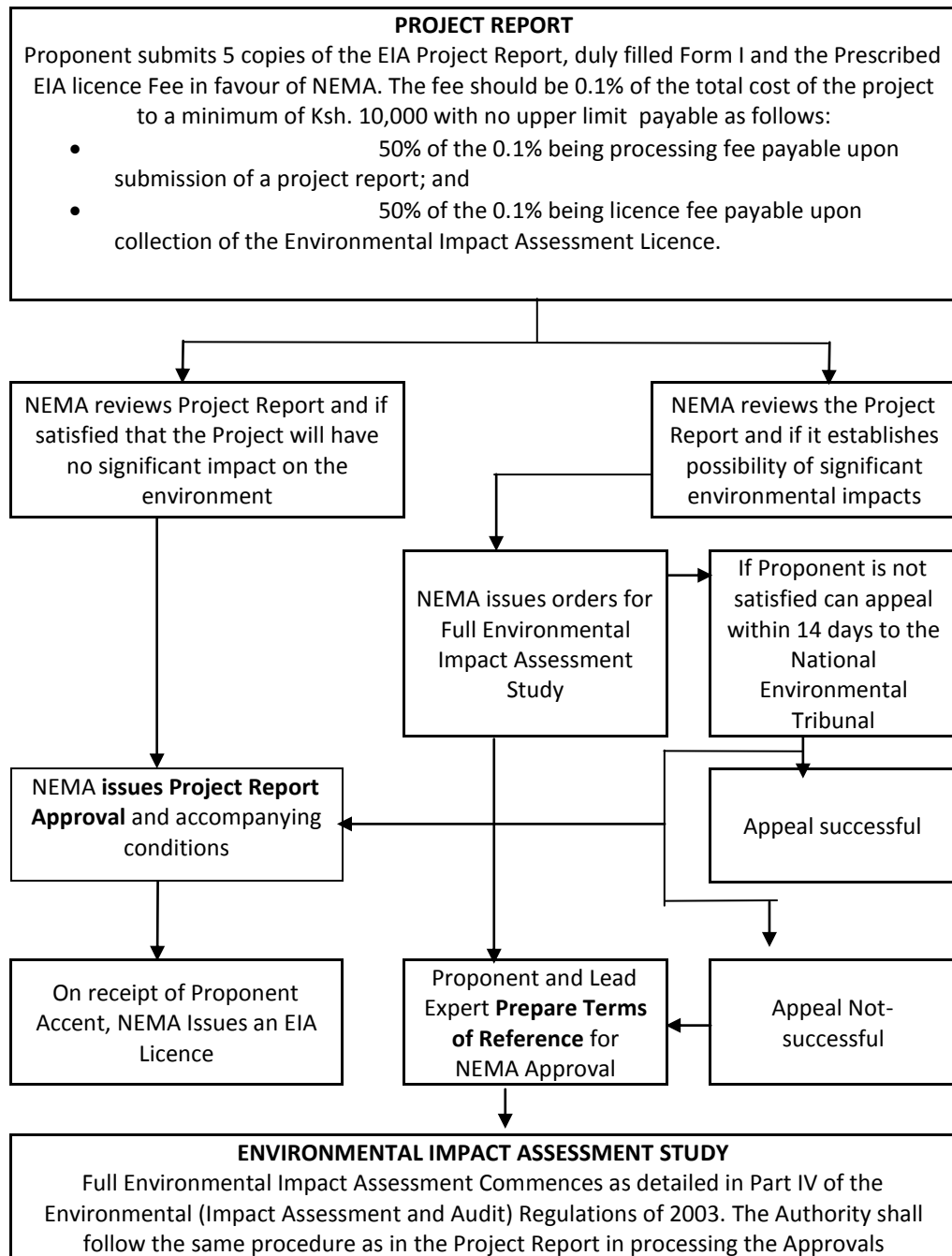


Figure 2.1 schematic presentation of the current EIA process in Kenya

3. PROJECT REPORT

The proponent submits at least 5 copies of the EIA Project Report, duly filled Form I

NEMA reviews Project Report and if satisfied that the Project will have no significant impact on the environment;

NEMA reviews the Project Report and if it establishes possibility of significant environmental impacts;

NEMA issues orders for Full Environmental Impact Assessment Study

If Proponent is not satisfied can appeal within 14 days to the National Environmental Tribunal;

NEMA issues Project Report Approval and accompanying conditions Appeal successful On receipt of Proponent Accent, NEMA Issues an EIA Licence

Proponent and Lead Expert Prepare Terms of Reference for NEMA Approval Appeal Not-successful

4. ENVIRONMENTAL IMPACT ASSESSMENT STUDY

Full Environmental Impact Assessment Commences as detailed in Part IV of the Environmental (Impact Assessment and Audit) Regulations of 2003. The Authority shall follow the same procedure as in the Project Report in processing the Approvals

4.1 Key legislations related to the Environment

Environmental Management and Coordination Act, 1999

The National Environment Secretariat established in the early 1990's developed and established the Environmental Management & Coordination legislation that was enacted into law by the Kenya Parliament in 1999 and commenced on 14th January 2000. This act of parliament was to provide for establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto'.

The main objectives of the Act are to:

- Provide guidelines for the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya;
- Provide a framework legislation for over 70 statutes in Kenya that contain environmental provisions; and
- Provide guidelines for environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders.

The Act defines environment to include the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics and includes both the natural and the built environment. There was established through this Act, the National Environmental Management Authority that was charged with overall protection of the environment and implementation of EMCA. The Authority carries many tasks pertaining to the environment among them the protection and conservation of the environment under Section 42.

Section 42 (1) of EMCA 1999 states that 'no person shall, without prior written approval of the Director-General given after an environmental impact assessment, in relation to a river, lake or wetland in Kenya, carry out any of the following activities- which include,

- Excavate, drill, tunnel or disturb the river, lake or wetland;
- Direct or block any river, lake or wetland from its natural and normal course or;
- Drain any lake, river or wetland.

Section 70 (1) establishes a Standards and Enforcement Review Committee in the Authority. Among the tasks the Committee is engaged in consultation with lead agencies in Section 71 include;

- Advise the Authority on how to establish criteria and procedures for the measurement of water quality
- Recommend to the Authority minimum water quality standards for all waters in Kenya and for different uses, including.
 - i. Drinking water
 - ii. Water for industrial purposes
 - iii. Water for agricultural purposes
 - iv. Water for recreational purposes
 - v. Water for fisheries and wildlife and;
 - vi. Any other prescribed water use.
- a. Prepare and recommend to the guidelines or regulations for the preservation of fishing areas, aquatic areas, water sources and reservoirs and other areas where water may need special protection.
- b. Advise the Authority to carry out investigations of actual or suspected water pollution including the collection of data
- c. Advise the authority to take steps or authorize any works to be carried out which appear to be necessary to prevent or abate water pollution from natural causes or from abandoned works or undertakings;
- d. Document the analytical methods by which water quality and pollution control standards can be determined and appoint laboratories for the analytical services required or request the DG to establish such laboratories.

The proposed Lowaat dam and irrigation development project will develop up to 1200Ha of irrigable land and therefore qualifies for an environmental impact assessment. Further to that, the water in the project area to be used for irrigation has been assessed against the set irrigation standards and found to be suitable.

Water Act 2002

The Water Act 2002 was enacted in response to the Water Policy of 1999 and as a repeal of the Water Act (Cap.372) and certain provisions of the Local Government Act. It does provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; the regulation and management of water supply and sewerage services. The Water Act came into operation on 24th October 2002.

Section 7(1) of the Water Act 2002, thereby establishes the Water Resource Management Authority whose mandate among others is to; Section 8 (1) (b) to monitor, and from time to time reassess, the national water resources management strategy and Section 8 (1) (e) to regulate and protect water resources quality from adverse impacts

Section 8 (1) (h) to gather and maintain information on water resources and from time to time publish forecasts, projections and information on water resources and

Section 8 (1) (j) to advise the Minister concerning any matter in connection with water resources. Thus the Water Act empowers the Water Resource Management Authority (WRMA) to monitor water sources for not only utilization but also for quality.

The Minister for water is further given mandate to classify in terms of quality any water resource within the Republic of Kenya for the sole objective determining its suitable use. In the following sections;

Section 12 (1) The Minister shall prescribe a system for classifying water resources for the purpose of determining resource quality objectives for each class of water resource

Section 12 (2) under the prescribed classification system water resources may be classified according to type, location or geographical or other factors.

Section 12(3) (b) specify the resource quality objectives for water resource of the class to which it belongs

Section 12 (3) (c) specify the requirements for achieving the objectives, and the dates from which the objective will apply.

Section 18 (1) The national water resources management strategy shall provide for national monitoring and information systems on water resources.

Section 25(1) (a) A permit shall be required for any use of water from a water resource except as provided by section 26.

Section 26(1) Except as provided by subsection (2), a permit is not required-

(a) For abstraction or use of water, without the employment of works, from or in any water resource for domestic purposes by any person having lawful access thereto

(b) For any development of ground water, where none of the works necessary for development are situated,

a. Within one hundred metres of any body of surface water (other than inclosed spring water as defined in subsection (3)); or

b. Within a ground water conservation area.

Section 47 The Regulatory Board shall have the following powers and functions

(a) To issue licenses for the provision of water services

(b) To determine standards for the provision of water services to Consumers. In essence the jurisdiction of water resources quality and water quality is in the hands of the Water Resources Management Authority.

Agriculture Act Cap 318

This is an Act of Parliament for the promotion and maintenance of a stable agriculture, to provide for the conservation of soil and its fertility and to stimulate the development of

agricultural land in accordance with accepted practices of good land management and good husbandry. Under Section 184 of the Act the Minister may make general rules for the preservation utilization and development of agricultural land. The irrigation scheme land in general is agricultural and is therefore subject to this Act.

The Land Acquisition Act, Cap. 295

This Act gives powers to the government to acquire any person's land for public utilities. The act however stipulates that once such land is acquired, prompt and full compensation be paid to the owner. The government determines the level and mode of such compensation. The proposed irrigation project shall utilize both public and private land in the project area which if found to be suitable, it may be acquired for the same.

Land Control Act (Cap 406)

This law provides for the control of transactions in land, especially under the responsibility of the Land Control Boards. However, it is of environmental interest that one of the points to consider in granting or refusal of consent by the Board is what impact the transaction is likely to have on the maintenance or improvement of standards of good husbandry within the specific agricultural area. Government land is land owned by the Government of Kenya under the Government Lands Act (Cap 280). Trust land is land held and administered by various local government authorities as trustees in the Constitution of Kenya and Trust Land Act (Cap 288). Individuals may acquire leasehold interest for a specific number of years in trust land and can (in theory) be repossessed by the local authorities should the need arise. Local authorities retain regulatory powers over trust land.

The Physical Planning Act

This Act provides for the preparation and implementation of physical development plans for any development or infrastructure. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning. It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in a specific plan. The intention is that the three-tier order plans, the national development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues. The Act also promotes public participation in the preparation of plans and requires that in preparation of plans, proper consideration be given to the potential for socio-economic development needs of the population, the existing planning and future transport needs, the physical factors which may influence orderly development in general and urbanization in particular, and the possible influence of future development upon natural environment.

Forest Act of 2005

This law was enacted by Parliament in 2005 to provide for the establishment, development and sustainable management including conservation and rational utilization of forest resources for the socio-economic development of the country. A few Parts of the irrigation scheme consist of indigenous trees especially on hills. Section 8 of the Act requires all indigenous forests and woodlands to be managed on a sustainable basis for the purposes inter alia of conservation of water, soil and biodiversity, riverline and shoreline protection, sustainable production of wood and non-wood products. Community participation as provided for under Section 46 of the Act should be encouraged. The most appropriate would be initiation of participatory forest management in these forest reserves so that the local community and organization such as farmers in the irrigation scheme can have a significant

input with Kenya Forest Service (KFS) office playing a coordination and guidance role.

Public Health Act (cap 242)

Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 as waste pipes, sewers, drainers or refuse pits in such state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or waste water flowing or discharged from any premises into the public street or into the gutter or side channel or watercourse, irrigation channel, or bed not approved for discharge is also deemed as nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

On responsibility of the Local Authorities Part XI, section 129, of the Act states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its Sub-county has a right to use and does use for drinking or domestic purposes.

Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by section 126A that requires local authorities to develop by laws for controlling and regulating among others private sewers, communication between drains and sewers and between sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter. Part XII, Section 136, states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the matter provided by this Act.

Registration of Titles Act Chapter 281 of the Laws of Kenya

The Registration of Titles Act is an act of Parliament that provides for the transfer of land by registration of titles. When the Commissioner of land issues a letter of allotment to any person in respect of any land, one of the laws under which the title to that land is issued is the Registration of Titles Act. A freehold title issued under this act confers absolute control upon individuals or other legal entities upon a given parcel of land. It also confers upon them power to determine the use to which such land can be put. A leasehold title contains conditions such as the term of the lease, commencement date thereof, the user of the land etc.

Private ownership of land is embodied in this Act. There are two land registries in the country for the registration of land under this act. There is the Coastal Registry which covers land registration in the coastal area and the Inland Registry in Nairobi which covers land in the rest of the country. The title to individual land parcels are registered at the inland Registry in Nairobi.

Government Lands Act (cap 280);

The Government Lands Act, Chapter 280 of the Laws of Kenya Under this act government

lands are vested in the President who has powers to inter alia make grants or dispositions of any estates, interests or rights in or over unalienated government land. Unalienated government land is land which is not presently leased to any person and in respect of which the Commissioner of Lands has not issued a letter of allotment. Some of these powers have been delegated and are exercised by the Commissioner of Lands. The President through the commissioner of lands may allocate any unalienated land to any person he so wishes on private tenure basis. Once allocated, such land is held as a grant from the government on payment of such rents or conditions as the government may determine. Such allocations have often disregarded social and environmental imperatives, leading to degradation, inequity and other undesirable impacts.

The Government Lands Act is key to the discourse on communal tenure rights in that in some communities, land used pursuant to communal tenure systems is in fact Government land usually what is known as unalienated government land. The communities in the project area hold the land on which they live and derive their livelihood on communal tenure basis. These communities may under this Act enter into leases or licenses with the Government for the land they use. However, given the nature of communal tenure regimes, it is unlikely that communities may wish to formalize relationships with the government. They may not see the rationale in entering into a formal relationship that are subject to rents and other conditions in situations where they may in fact be using such land in remote areas unimpeded. Any grant of title to any land that is occupied by the communities will be done under this Act.

Trust Land Act (cap 288);

The constitution vests all land which is not registered under any act of parliament under the ownership of local authorities as trust land. Section 117 of the Constitution of Kenya provides that the Trust Lands Act may empower a county council to set apart an area of trust land vested in that county council for use and occupation by a public body or authority for public purposes, or by any person for a purpose likely to benefit the persons within the jurisdiction of the county council or for the purpose of prospecting or extraction of minerals or oil.

Trust land consists of areas that were occupied by natives during the colonial period and which have not been consolidated, adjudicated and registered in individual's or group names. It also includes native land not taken over by the Government. Trust land is governed by the Trust Lands Act and is vested in local authorities designated as councils. The councils manage all resources within trust land and regulate land use such and conservation within their jurisdictions. The land in the project area which has not been adjudicated falls under this Act.

Wildlife (Conservation and Management) Act (Cap 376)

The Wildlife (Management and Conservation) Act was established to “consolidate and amend the law relating to the protection, conservation and management of wildlife in Kenya; and for purposes connected therewith and incidental thereto”. The Wildlife (Management and Conservation) Act recognizes the need to balance wildlife conservation and management with the varied forms of land use. By way of a 1989 amendment, the Wildlife Act established the Kenya Wildlife Service (KWS), a state corporate body with the above objectives and the following functions:

- i. Formulation of policies regarding the conservation, management and utilization of all types of fauna (not being domestic animals) and flora;
- ii. Advising the government on the establishment of National Parks, National Reserves and other

- protected wildlife sanctuaries;
- iii. Management of National Parks and National Reserves;
- iv. Sustenance of wildlife to meet conservation and management goals;
- v. Conduct and coordinate research activities in the fields of wildlife conservation and management;
- vi. Provision of advice to the government, local authorities and landowners on the best methods of wildlife conservation and management and to act as the principal instrument of the government in pursuit of such ecological appraisals or controls outside urban areas as are necessary for human survival; and
- vii. Administration and coordination of international protocols, conventions and treaties regarding wildlife in all its aspects.

Land titles Act Cap 282

The Land Titles Act Cap 282 section 10 (1) states that there shall be appointed and attached to the Land Registration Court a qualified surveyor who, with such assistants as may be necessary, shall survey land, make a plan or plans thereof and define and mark the boundaries of any areas therein as, when and where directed by the Recorder of Titles, either before, during or after the termination of any question concerning land or any interest connected therewith, and every area so defined and marked shall be further marked with a number of other distinctive symbol to be shown upon the plan or plans for the purposes of complete identification and registration thereof as is herein after prescribed

Way leaves Act Chapter 292 of the Laws of Kenya

Section 3 of the Act empowers the Government to carry any sewer, drain or pipeline into, though, over or under any lands whatsoever, but may not in so doing interfere with any existing building. Section 8 further states that any person who, without the consent of the Permanent Secretary to the Ministry responsible for works (which consent shall not be unreasonably withheld), causes any building to be newly erected over any sewer, drain or pipeline the property of the Government shall be guilty of an offence and liable to a fine of one hundred and fifty shillings, and a further fine of sixty shillings for every day during which the offence is continued after written notice in that behalf from the Permanent Secretary; and the Permanent Secretary may cause any building erected in contravention of this section to be altered, demolished or otherwise dealt with as he may think fit, and may recover any expense incurred by the Government in so doing from the offender.

Occupational safety and health Act, 2007

The Act makes provisions for health, safety, and welfare of person employed in places of work. Part IV of the Act covers Health issues, which includes;- The state of cleanliness; Refuse management; Employee space requirement; Ventilation and sanitary conveniences, etc. while,

Part V covers Safety: Operation and maintenance of machinery, fencing requirements, storage of dangerous substances, training, and supervision of workers.

Part VI deals with Welfare issues, which include:-The supply of drinking water for the workers; Making available washing facilities; sitting areas and first aid provision.

4.2 Regulations

2.4.1. The Environmental (Impact Assessment and Audit) Regulations, 2003

The Environmental (Impact Assessment and Audit) Regulations, 2003 state in Regulation 3 that “the Regulations shall apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V and the Second Schedule of the Act”. Regulation 4(1) further states that:

“...no Proponent shall implement a project:

- (a) likely to have a negative environmental impact; or
- (b) for which an environmental impact assessment is required under the Act or these Regulations

Unless an environmental impact assessment has been concluded and approved in accordance with these Regulations...”

2.4.2. Environmental Management and Coordination (Water Quality) Regulations

2006 (legal notice no 121)

The EMCA (Water Quality) Regulations 2006 are set to apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. The objective of the regulations is to protect human health and the environment. The effective enforcement of the water quality regulations will lead to a marked reduction of water-borne diseases and hence a reduction in the health budget.

Everyone is required to refrain from any actions, which directly or indirectly cause water pollution, whether or not the water resource was polluted before the enactment of the Environmental Management and Coordination Act (EMCA) gazetted in 1999. It is an offence to contravene the provisions of these regulations with a fine not exceeding five hundred thousand shillings. Regulation 20 of these regulations provides for compliance with water quality standards for irrigation. It states that ‘ Where the Minister, in exercise of his powers conferred under Section 42 (3) has issued an order for the management of a natural water body, no person shall abstract water from such body for irrigational purposes unless such water meets the standards set out in the Ninth Schedule to these Regulations’. Table 2:1 shows the quality standards for irrigation water

Regulation 21 of these regulations requires the creation of a buffer zone between an irrigation scheme and a natural water body and it states “Any owner or operator of an irrigation scheme shall create a buffer zone of at least 50 meters in width between the irrigation scheme and the natural water body into which such irrigation scheme discharges its waters”.

The proposed irrigation development project shall be subject to the water quality standards for irrigation throughout its lifecycle. The water sampling and testing found the water generally suitable for irrigation.

2.4.3. Environmental Management and Coordination (Conservation of Biological Diversity) Regulations, 2006

These regulations are described in Legal Notice No. 160 of the Kenya Gazette Supplement No. 84 of December 2006. These Regulations apply to conservation of biodiversity which includes conservation of threatened species, inventory and monitoring of biological diversity and protection of environmentally significant areas, access to genetic resources, benefit sharing and offences and penalties.

2.4.4. Water Resources Management Rules, 2007 (legal notice no 171)

Following the enactment of Water Act 2002, the Water Resource Management Authority (WRMA) came into operation in 2005 and went forth to publish the Water Resources Management rules in 2007. These rules are for the operationalization of the legislation, the Water Act 2002, on the management of water resources in Kenya.

Section 4 (2) says the Rules apply to all water resources and water bodies in Kenya, including all lakes, water courses, streams and rivers, whether perennial or seasonal, aquifers, and shall include coastal channels leading to territorial waters.

Section 73 (1) regulation of the groundwater development, the Authority will determine in the allocation plan for a given aquifer or part thereof, the spacing of boreholes, or wells to be equipped with motorized plant and will be guided by-

- (a) Existing borehole or well spacing
- (b) Individual aquifer characteristics, including water quality
- (c) Existing aquifer use and
- (d) Existing bodies of surface water

Section 79 states that the Authority may from time to time and in carrying out its responsibilities towards groundwater resources management require any person or entity, permit holder or operator, to provide it with abstraction, water levels, water quality or any other specified information within reasonable time or on a regular basis.

Section 80 gives the Authority the mandate to maintain groundwater database.

4.3 Relevant institutions

4.3.1 National Environment Management Authority

The National Environment Management Authority (NEMA) is established under Section 7 of the Act. NEMA is the institution with the legal authority to exercise general supervision and co-ordination over all matters relating to the environment, and is the principal instrument of the Government charged with the implementation of all policies relating to the environment. NEMA was established in 2001, and is headed by a Director General appointed by the President. The Director General is assisted by several directors in charge of Enforcement, Education, and Policy, who in turn are assisted by Assistant Directors and Senior Officers. To facilitate coordination of environmental matters at a County level, EMCA 1999 allows for the creation of County Environmental Committees (CEC) chaired by respective County

Commissioners, and the appointment of a County Director of Environment who oversees environmental coordination and is also secretary to the CEC.

4.3.2 . National Irrigation Board

The NIB is a semi-autonomous body, established under the Irrigation Act of 1966, and is responsible for planning, construction, settling and managing national irrigation schemes.

4.3.3. Ministry of Water and Irrigation

The Ministry of Water and Irrigation is the parent institution for this project. The NIB is under this Ministry. The Ministry of Water and Irrigation has its fundamental goal and purpose as conserving, managing and protecting water resources for socio-economic development. Its aim is to improve the living standards of people by ensuring proper access to available water resources. The fact that this ministry is only concerned with the development of irrigation infrastructure and management of water resources, the operation of the crop is the mandate of Ministry of Agriculture.

4.3.4. Ministry of Health

The Ministry of Health through the Public Health Division is involved in the provision of preventive healthcare through mobilizing and sensitizing of communities on water and sanitation matters through identification, planning and selecting appropriate. Technologies, water quality surveillance, water supply improvement at household and small group's levels, water quality monitoring and prosecution of offenders and environmental sanitation and hygiene promotion. The Ministry of Health lays emphasis on promotion of preventive health and hygiene and in this regard, management of water quality and adequate sanitation are given prominent consideration.

4.3.5. Ministry of Agriculture

The mandate of the Ministry of Agriculture is to promote and facilitate production of food and agricultural raw materials for food security and incomes; advance agro based industries and agricultural exports; and enhance sustainable use of land resources as a basis for agricultural enterprises. Some of the relevant functions of the Ministry in regards to the project are formulation, implementation and monitoring of agricultural legislation's, regulations and policies, provision of agricultural extension services, supporting agricultural research and promoting delivery, development, implementation and coordination of programs in the agriculture sector, regulating and quality control of inputs, produce and products from the agriculture sector, management and control of pests and diseases in crops and promoting management and conservation of the natural resource base for agriculture.

4.3.6. Water Resources Management Authority

The Water Resource Management Authority (WRMA) is a state corporation under the Ministry of Water and Irrigation established under the Water Act 2002 and charged with being the lead agency in water resources management. The duties of WRMA include; Water apportionment and allocation, catchment, Catchment protection and conservation, Water resource assessments and conservation, Delineation of catchment areas, Gazetting water protected areas, Protection of wetlands, Gazetting water schemes to be state and community owned, Establishing Catchment Management Strategies (CMS) Collecting water

use and effluent discharges. The water Act provides for decentralized and stakeholder involvement. This will be implemented through regional offices of the Authority based on drainage basins (catchment areas) assisted by Catchment Area Advisory Committees (CAACs). At the grassroots level, stakeholder engagement will be through Water Resource User Associations (WRUAs).

4.3.7. Ministry of Livestock and Fisheries

Due to reduced grazing land for livestock in the project area, the Ministry of Livestock and Fisheries will be responsible for promoting improved breeds of cattle and zero grazing.

4.3.8 International Regulations, Conventions and Treaties

Regulations, Conventions and treaties are legally binding bilateral, regional or international agreements that binding to the states that are parties thereto. Kenya has ratified some of the most important agreements on the environment and is bound by the same. The relevant ones are cited and briefly discussed overleaf.

4.3.9 Convention on Biological Diversity (CBD)

The CBD is one of the outcomes of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The CBD establishes a global legally binding framework for the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of utilization of genetic resources. The provisions of this convention should be taken into account in the conservation of various species of plants, animals and the variety of ecosystems in the project area.

4.3.10 Convention on the Conservation of Migratory Species

The convention on migratory species (CMS) was adopted to conserve migratory species of wild animals given that migratory species are seen as an international resource. Such species may be terrestrial or marine. The convention's agreement on the conservation of African-Eurasian migratory water birds is specific on the need to protect the feeding, breeding and wintering habitats, the main ones being wetlands and open water.

5. PROJECT DESCRIPTION

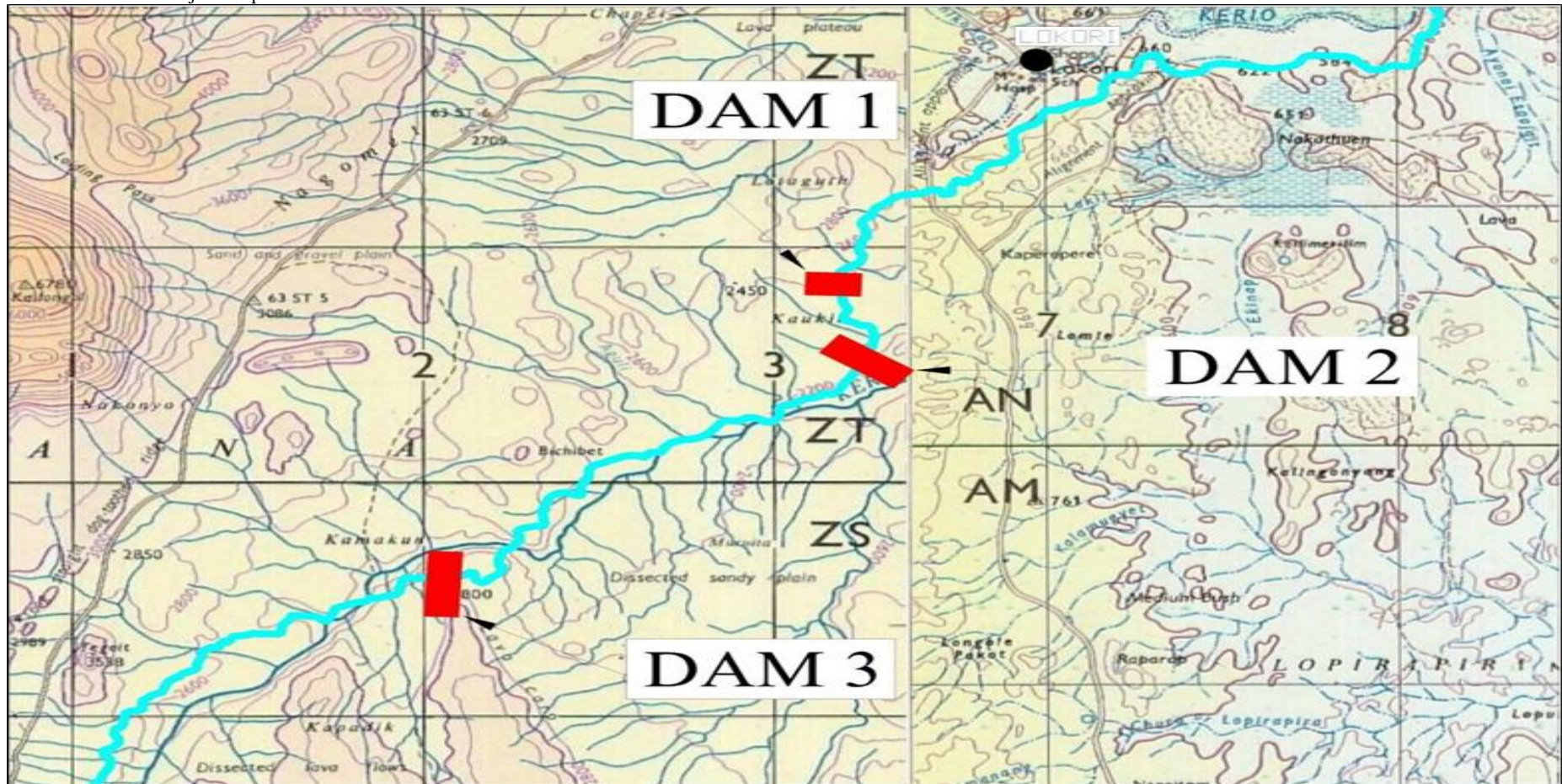
5.1 PROJECT DETAILS

The proposed Lowaat Dam site is located approximately 180km Upstream of Lake Turkana. The coordinates of the site obtained using are 0832725 and 020494301. The altitude of the site is approximately 740m above sea level.

The catchment area associated with the Kerio River stretches from Uasin Gishu Sub-county and includes Iten Town, Kabarnet Town and large parts of Kabarnet Sub-county. It covers an area of 7,429 km². The catchment area associated with river Kerio is largely the semi-arid area to the North East of Eldoret. It covers an area of approximately 2,847km². The total combined catchment area is therefore 10,276 km² with 35% in arable lands and 65% in semi arable lands.

Figure 5.1: Location sketch map of the proposed Lowaat dam.

emba



5.2 NATURE OF THE PROJECT

The nature of the project will in the course of development involve three stages namely Site Preparation, Construction and Operation Phases. The envisaged implementation time frame for the proposed project is estimated to be two hydrological years depending on rainfall pattern i.e after obtaining approval from NEMA.

During Site Preparation phase the project area was surveyed for dam construction suitability through a number of tests. The concept was to determine the nature of the soil and geology critical in dam construction.

5.3 INPUT RAW MATERIALS

Foundation design

Bed rock foundations that are compact and erosion resistant are the most desirable for rock fill dams. All materials in cracks, faults, or deep pits that may eventually erode into the rock fill from the abutments or foundation will be filled with filters or backfilled with concrete. All joints and cracks beneath the core and filters will be also cleaned and filled with concrete. The usual methods of treating foundations to prevent under seepage i.e. grouting will be considered. Grouting will be done along one centre line along the dam axis and then one row on either side of the center line where secondary holes will be drilled, cleaned and grouted until full closure is achieved. Treatment of the foundation must be sufficient to satisfy the following criteria:

- Minimum leakage;
- Prevention of piping ;
- Limited settlement ; and
- Sufficient friction development between abutments and foundation to ensure sliding stability.

(a) **Alignment**

The alignment has been selected based on contour layout to give the shortest crest length and allow for the economical location of the Spillway route and outlet works. In the preliminary design, the crest elevation is 678 and 470m long.

(b) **Embankment slopes**

Materials found in the general study area are volcanic rocks. This are the materials that will be used to construct the dam. Thus the recommendations on United States Bureau of Reclamation (USBR) manual for the slopes of embankments for the upstream and downstream slopes, slopes of 1:3 and 1:2.5 will be adopted.

These slopes will be sufficient to provide stability of the dam against slip circles. In the analysis of slope stability, the Consultant will use the parameters of the soils that will be established from the geotechnical investigation of recovered samples after analysis in the laboratory.

Downstream Slope Protection

The downstream slope will be protected by planting suitable grass on a 25cm thick red soil. Equally, two No. 5m wide berms will be place at convenient levels and they will drain runoff water to the abutments for final evacuation to the downstream end of the dam near the rock toe drain.

5.4 PROJECT JUSTIFICATION

For meaningful development of this area, there is need to provide reliable water through construction of small dams within this locality. Such a dam would aim at:

- Providing reliable water for irrigation;
- Providing reliable water supply for domestic use;
- Reducing conflicts between the pastoralist and farmers;
- Generating electricity;
- Enhancing fish farming;
- Boosting tourism; and
- Reduce conflicts between the pastoralists in the Kerio River Basin.

5.5 PROJECT ALTERNATIVES

The design of Rock fills and earth dams has to ensure that a safe and economical structure is constructed. In this regard, the following considerations are pertinent:

- The slopes of the embankment must be stable under all conditions of construction and operation, including rapid drawdown of the reservoir;
- The embankment wall and the water in the reservoir must not overstress the foundation;

- The foundation under the reservoir area must be water tight. In the event of fissures, the pressure grouting must be done;
- Seepage flow through the embankment, foundation and abutments must be controlled so that piping, sloughing or removal of material by solution does not occur;
- The dam height and freeboard must be sufficient to prevent overtopping by the waves and include an allowance for settlement of the foundation and embankment;
- Spillway together with the outflow sections must be adequate to prevent overtopping of the embankment wall and thus ensure the hydrological safety of the dam. The slopes of spillway and outflow sections must be stable under all operational conditions;
- The hydrology of the river systems should be such that the runoff may fully impound the reservoir within a given period of time. Secondly the flows during the dry period should be adequate to maintain the reservoir;
- The spillway should be designed in such a manner as to ensure hydrological safety of the dam;
- The terminal points of the spillways will have an energy dissipater to dissipate the kinetic energies of the flows lest these energies erode the river banks;
- The catchment area should not be very degraded as to yield huge sediment loads which would reduce the economic lifespan of the dam. Environmental conservation programs should be initiated within the catchment area and these would have to be done through a multisectoral approach; and
- The dead storage of the reservoir should be selected as a function of the sediment loads and should reflect the economic lifespan of the dam

6. DESCRIPTION OF EXISTING ENVIRONMENT

6.1 INTRODUCTION

The prevailing environment baseline conditions in the area were assessed using appropriate standard methodologies. The approach involved undertaking inventory of physical and biological environments, conducting interviews with citizens and reviewing of relevant literature. Sources of literature that was reviewed included public and private offices, libraries and reports on past studies relevant to the area. The subject matter of interviews included but not limited to forest products and services obtained, the natural resource management practices in the area with reference to what used to obtain decades ago.

6.2 PHYSICAL ENVIRONMENT

Geology

Geological survey of the Lowaat dam site were done and it was established from the investigations outcome that the foundation characteristics of the site presents a geological formation of Basalts rocks fragments, fractured phonolite rocks (Pyroclastic material) of agglomeratic deposits of poorly sorted, angular lithic and igneous material overlaying highly weathered to fresh porphyritic basalt rock.

Results of soil survey indicate that the soils in Lowaat Dam Site area are grayish brown sand and rocky material where drainage is very good. The soils are shallow and stony passing quickly into weathered and decomposed igneous rocks.

The results of core drilling confirmed that rocks are weathered and fractured at the top and the geological section is composed of fractured igneous rocks separated by old land surface deposits. However, due to the high drainage nature and weathering of the parent rock, it will be necessary to excavate up to a depth of about 6m depth and then do grouting in order to minimize possible seepage under the dam.

Climate

Lokori has been classified as an Arid and Semi-Arid Land (ASAL) Sub-county. The climate is characterized by warm to hot, with temperatures ranging between 24 to 40 degrees Celsius.

Rainfall is erratic and unpredictable both in timing and distribution. Moreover, most of the precipitation is run off through the myriad of seasonal streams and rivers that drain the highlands that surround the area. However, in general, the rainy season comprises long rains between April and August, and short rains between October to November. January, February and September tend to be the driest periods. Rainfall tends to be the highest in the western parts of the Sub-county and other areas of high elevation. For the last two decades, the ASAL Sub-countys have frequently suffered from failures in the annual rains but 2006 and 2007 witnessed a higher than expected rainfall. Conversely, flooding is also possible when there is too much rain like it was witnessed in October 2006 where many parts of the Turkana Sub-county experienced losses of livestock and small garden crops due to the flush waters. The average annual rainfall ranges from 300mm to 400mm.

6.3 SOCIO-ECONOMIC ENVIRONMENT

The main economic activities is nomadic pastoralism. Irrigation activities in some of the farms stretch right up to the banks of the river. Livestock keeping includes cattle, goats, and donkeys.

Population

According to the 2009 Census Turkana East Sub-county registered a total population of 226,379 people, projected to 339,155 in 2019, and about a 500,000 million in 2029. The areas targeted to benefit from water supply proposed dam include Lokori, Lochokula and Katilia locations.

When water becomes available people from the densely populated divisions and elsewhere will be attracted and migrate to the region with resultant increase in population.

The population in the various locations in the region is shown in Table 1.1.

Table 6.2: Population of the project area in 2009

Demographic Characteristic of the project Area			
Location	Area (Km ²)	Population	Population Density (Persons/Km ²)
Lokori	1,639	32,682	19.94
Lochokula	1,020	6,514	6.39
Katilia	3,338	20,983	6.29
Total	5,997	60,179	10.04

The population that is likely to benefit directly from the Lowaat dam project lies mainly in Lokori, Lochakula and Katilia Locations within Lokori Division, Turkana East Sub-county which had a combined population of 60,179 in 2009, estimated to reach 118,373 in 2019. These cover an area of 5,997km² and hold about 35% of total population of Turkana East Sub-county.

The population is generally youthful with those below 15 years accounting to 47% equivalent to 29,000 in 2009 and projected to reach 56,000 in 2019. This implies that the effect and impact of the proposed dam could provide great opportunities and boost to the economic development of the Sub-county.

7. POTENTIAL ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

7.1 GENERAL CONSIDERATIONS

Construction of dams and associated reservoirs are usually planned for single or multipurpose use that include hydropower generation, domestic and industrial water supply, flood control and irrigation

Although adequate bulk water storage is desired world over for sustainable agricultural production, large scale dam projects if not properly planned and managed may cause irreversible environmental changes over a wide geographical area and thus have the potential for significant impacts. Criticism of such projects has grown in the last decade.

The main objective in assessing the potential effects of this project was essentially to permit planning of actions to avoid or reduce undesirable effects. Actions to enhance secondary benefits of the project were also identified. A project may exert a suite of effects during construction that largely end when the project comes into operation. It is therefore common practice to discuss the effects of the project construction (including preparatory phase if any) separately from those of project operation.

Creating a dam or reservoir fundamentally alters the hydrological regime upstream and downstream of the designed obstruction. This can have far reaching consequences, which may not be localized to the project area. These should be taken into consideration during the environmental impact assessment and incorporated into the design development. In many cases the area of influence of a dam project extends from the upper limits of the Catchment of the reservoir to as far downstream as the estuary and off-shore zone. It includes the watershed and river valley below the dam.

There are direct environmental impacts associated with the construction of the dam (e.g. dust, erosion, borrow and disposal problems), the greatest impacts are expected from the impoundment of the water flow downstream. These effects will have direct impacts on soil, vegetation, wildlife and wild habitat, fisheries and more especially human population within the project area.

On the other hand, indirect effects are expected, these include those associated with the construction or buildings, maintenance and functioning of the dam (e.g. access roads, irrigation facilities made possible by the dam). However, it should be noted that major environmental factors affecting the functioning and life span of a dam are those caused by land, water and other resource use in the Catchment upstream the dam (e.g. agriculture, settlement, forest clearing) which may result in increased siltation and changes in water quality in the reservoir and river downstream.

Nonetheless, in spite of the above, the benefits of a dam project are immense, e.g. flood control and the provision of more reliable water supply throughout the year for irrigation, domestic and industrial use as well as environmental flows for aquatic ecosystem. Dams are also said to provide an alternative to activities with greater potential for greater adverse impacts. For instance, intensification of agriculture locally through irrigation can reduce pressure on uncleared forest lands, intact wildlife habitat and areas unsuitable for agriculture elsewhere. In addition, dams create a reservoir for fishery and possibilities of

agricultural production on the reservoir drawdown area, which in some cases can be more than compensating for losses in these sectors due to dam construction.

Therefore, this section of the environmental report addresses the interactions of the project with the natural and socio-economic resources around it. These interactions are normally known as 'impacts'. Many of the effects of the proposed project may be secondary benefits though not part of the objective of the project. It is worthwhile separating project effects into direct (or primary) effects resulting from direct interaction of some components of the project with one or more environmental resources, and indirect (or secondary) effects which arise from the primary effects. Note that a classification of negative effect does not necessarily imply a long-term adverse effect on the environment. It may as well indicate an irreversible change to the physical environment from original conditions. In some cases, these irreversible changes can result in favourable long-term effects.

7.2 PREDICTION OF IMPACTS

The proposed Lowaat Dam Project is expected to have both negative and positive impacts. As earlier stated, primary impacts may be followed by secondary and tertiary ones e.g. sedimentation and eutrophication of reservoir water reduces the oxygen content of the water downstream and results in secondary effects like the spread of aquatic weeds and eventually in tertiary effects like disease vectors and fish mortality. The following broad division into impact zones was made;

- (i) Areas influenced by hydrological changes in the river system: Reservoir area where there reservoirs will be created following the closure of the dam and area immediately below the dam.

7.3 IMPACT CLASSIFICATION AND CRITERION

With the understanding derived from general considerations and prediction of impacts highlighted earlier, a number of impacts (positive and negative) were identified. These impacts are based on the design of the dam, project details, environmental and socio-economic baseline study as well as expert judgment. In order to be thorough with the manner in which impacts were classified, the water course was segmented into four sections and under each section associated impacts identified.

Table 7.1. general impacts associated with dam construction

Category	General	Above dam	Below dam	Barrier effect
General Impacts	Loss of terrestrial habitats/farmland/settlements	Loss of river section	Reduced flows	Blocking of Migration of
	Local rise in water table	Changes in flow regime	Reduced oxygen levels	Blocking of Migration of invertebrates
	Visual impacts of retaining walls	Siltation	floodplain siltation	
	Water borne pathogens			
	failure risks			

7.4 POSSIBLE ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

For purposes of this report, possible impacts have been categorized based on classification and criterion outlined in table 7.2 below;

Table 7.2. criterion and classification of impacts

Item	Impact Criterion	Effect Consideration on Environment	Classification of Effect	
			Expression	Effect Description
I	Positive or Negative	Will impact be positive or negative	Positive	A positive impact
			Negative	A Negative impact
ii	Likelihood of occurring	What certainty of occurrence is associated with impact	Certain	Will occur
			Unlikely	May not occur
			Possible	May occur
iii	Duration	What timeframe or period is effect to be felt or last	Permanent	Will last a lifetime
			Short term	Will last up to end of construction activities
			Medium Term	Will last as long as operation activities
			Long Term	Will last beyond project operation life
iv	Timing	At what stage will impact occur or felt	Immediately	Will occur upon starting project activities
			Near Future	Will occur during project operation activities
			Distance future	Will occur beyond project operation activities
V	Significance	How severe will the impact be	Low	Little impact
			Medium	Moderate impact
			High	High impact

Item	Impact Criterion	Effect Consideration on Environment	Classification of Effect	
			Expression	Effect Description
Vi	Extent	Areal extent or coverage of impact	Project Area	Effect confined to project area
			Surrounding Environs	Effect to be felt by surrounding areas
			Beyond Surrounding Environs	Effect to be felt within, surroundings and beyond environs
Vii	Overall Rating	How important is Impact in project design	Insignificant	Impact not substantial needs no mitigation/
			Low	Impact of little importance needs limited mitigation / enhancement
			Moderate	Impact has influence and requires mitigating/ enhancing
			High	Impact of great importance mitigation/ enhancement a must

7.5 Dam wall and spillway construction

This will involve site clearing and stripping of subsoil i.e. removal of tree stumps and roots from the site foundation as well as removal of anthills. In addition river bed foundation preparations including removal of inferior material, core trench excavation and rock surface preparation under the earth wall core, spillway area and in the tail water section will be undertaken. Note that excavation and exploration of any joint fissures on faults in the rock, and their treatment will also be carried out.

The cross-section of the embankment shall comprise a height of 11.485m up to settled level, a crest width of 6m, upstream and downstream slopes of 1:2.5 and 1:2 respectively. The crest will be raised to a level of 0.57m from settled crest level to allow for a 5% settlement. A spillway length will be 60m.

Construction Stage

Impact: Displacement of people:

The number of people actually living in the Catchment area of the proposed reservoir was derived from census data and field surveys. It was established during field surveys that the project area particularly impoundment has no settlement and no households are expected to be relocated due to inundation.

Impact: loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to impoundment will be there though relatively small compared to the available arable land.

Impact: Loss of wildlife habitat, indigenous flora and fauna:

The project site will not interfere directly with any existing wildlife reserves or national parks. Wildlife is in fact expected to resurface in the area due to improved water supply. However, limited loss of some wildlife habitat and flora is expected while aquatic life will be enhanced.

Impact: Erosion of the top soil and reservoir sedimentation:

The nature of the project demands use of heavy machinery during construction mainly for earth movement and levelling. This may lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

Impact: Skills transfer to locals:

When the local people are employed during dam wall construction, they will acquire skills in construction which they can use later in future. By employing as many local people as possible there will be skills transfer thus building human capacity in the area.

Operation Stage

Impact: Pollution due to increased usage of pesticides and fertilisers:

Increased availability of water supply throughout the year for irrigation may lead to higher usage of agro chemicals. The contamination levels of the drainage water and the toxicity of the residue will depend on the dosage and frequency of use as well as on the types of agro chemicals used. Human health, fish and wildlife may be threatened due to high usage of agro-chemicals if done in unregulated manner.

Impact: Deterioration in water quality in downstream reaches of the stream:

Water quantity measures affect water quality in several ways. Impoundment may increase or decrease (dilution) the pollutant load of receiving waters while withdraws may indirectly lead to an increase of the pollutant loads, when water returns polluted to the source after use. Therefore, construction of a reservoir implies creation of a new environment, developing its own typical water quality problems that may affect the downstream areas to some extent.

Impact: Change in water quantity in downstream reaches of the stream:

The River will not be completely impounded but will allow environmental flows for both the ecosystem and any other activity that may be undertaken downstream at any given time.

Impact: Encroachment of aquatic weeds and water quality of the reservoirs:

The aquatic ecosystem in newly constructed reservoirs is very unstable and water is often eutrophic as a result of the inundation of fertile land. Explosive growth of certain plant species may seriously threaten the effective use of such reservoirs. In eutrophic circumstances, reservoirs can suffer a fast growth of unicellular algae, mostly of a blue green nature. Since these algae do not enter common food chains, these blooms are unfavourable to fish production.

Impact: Threat to public health:

Development of reservoirs in tropic countries usually leads to change in incidence of water-borne diseases. In Kenya, this may imply the spread of mosquitoes and vectors of malaria. This may threaten public health if no special attention and mitigation measures are put in place.

Impact: Dust pollution:

The project will take place in the dry season which is well known for dust circulation. Dust pollution is expected to pose a negative impact that can affect human health.

7.6 EQUIPMENT MOBILISATION AND OPERATION

The nature of the project requires use of heavy trucks and earth moving machinery. Taking these to site would require making access roads as well as a camp site with storage facilities for materials and lubricants. This will result in the disturbance of soil and vegetation and the likelihood of oil spillages. During operation, the dust will be generated and noise may disturb wildlife.

7.7 Construction Stage

Impact: Loss of wildlife habitat, indigenous flora and fauna

The activities at the project site will not interfere directly with any existing wildlife reserves or national parks. In fact Wildlife may resurface in the area due to improved

water supply. However, the exercise of mobilisation of equipment and machinery will lead to limited loss of some wildlife habitat and flora.

Impact: Erosion of the top soil and reservoir sedimentation

Mobilisation of heavy machinery to site for earth movement and levelling will cause instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

7.8 Operation Stage

Impact: Erosion of the top soil and reservoir sedimentation

During operation of heavy machinery for earth movement and levelling, soil in the area will be disturbed and as a result cause soil erosion mainly of top soil. Consequently this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

Impact: Soil and water pollution due to oil spills

Use of machinery which is not well maintained or serviced may lead to leakages thus polluting soils and consequently water resources.

Impact: Skills transfer to locals

When the local people are employed for operation of heavy machinery and equipment, they will acquire skills in operation and maintenance of the equipment and machinery which they can use later in future. By employing as many local people as possible skill transfer will be enhanced thus building human capacity in the area.

Impact: Dust pollution

The mobilisation of machinery and equipment will be done during dry season which is well known for dust circulation. Dust pollution is the expected negative impact that will pose a danger to human health.

7.9 BORROW PIT OPERATION, MATERIALS HANDLING AND REHABILITATION

Construction Stage

Impact: loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to creation of borrow pit will be there though relatively small compared to the available arable land.

Impact: Loss of wildlife habitat, indigenous flora and fauna

The project site will not interfere directly with any existing wildlife reserves or national parks. Wildlife is in fact may resurface in the area due to with improved water supply. However, formation of borrow pit will lead to limited loss of some wildlife habitat and flora.

Impact: Erosion of the top soil and reservoir sedimentation

Heavy machinery will be required during construction of the borrow pit. This would lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled

Impact: Dust pollution

Dust pollution is the most expected negative impact that will pose a health hazard. The project construction works will take place in the dry season known for dust circulation thus posing a danger to human health.

Impact: Loss of Cultural Sites

No cultural site is reported at the proposed site and as such none is likely to be affected. Should any site be discovered during operation the matter will be brought to the attention of the relevant authorities.

Operation Stage

Impact: Erosion of the top soil and reservoir sedimentation

Owing to the nature of the operation of a borrow pit, heavy machinery will be required for earth movement and excavation. This would lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

Impact: Dust Pollution

Dust pollution is expected during excavation and earth movement posing a health hazard especially that the project will take place in the dry season which is well known for dust circulation thus posing a danger to human health.

For a summary and evaluation of potential impacts see Table 5.3 during Construction Stage and Table7.3 during Operation Stage.

Table 7.3. Evaluation matrix for potential environmental impacts:-construction stage

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT
		POSITIVE(+VE) OR NEGATIVE (-EV) IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	RATING
ENVIRONMENTAL ISSUE: DAM WALL AND SPILLWAY CONSTRUCTION								
1	Displacement of people:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
2	loss of productive land	-VE	UNLIKELY	N/A	N/A	N/A	N/A	MODERATE/
3	historical and cultural sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
4	Loss of wildlife habitat, flora and fauna:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
5	Erosion of the top soil and reservoir	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	HIGH
6	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
7	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: EQUIPMENT MOBILISATION AND OPERATION								
8	Loss of wildlife habitat, flora and fauna:	-VE	UNLIKELY	SHORT TERM	IMMEDIATE	N/A	PROJECT AREA	INSIGNIFICANT
9	Erosion of the top soil and reservoir	-VE	CERTAIN	SHORT TERM	IMMEDIATE	MEDIUM	PROJECT AREA	MODERATE
ENVIRONMENTAL ISSUE: PRODUCTIVE AND SETTLEMENT LAND								
10	Displacement of people:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
11	loss of productive land/	-VE	UNLIKELY	SHORT TERM	N/A	N/A	N/A	INSIGNIFICANT
12	historical and cultural sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
13	Loss of wildlife habitat, flora and fauna:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: BORROW PIT OPERATION AND MATERIAL HANDLING								
14	loss of productive land, historical and cultural	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
15	loss of wildlife habitat, flora and fauna:	-VE	N/A	N/A	N/A	N/A	N/A	INSIGNIFICANT
16	Erosion of the top soil	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
17	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
18	Loss of Cultural Sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURRING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: WASTE MANAGEMENT								
19	Water Quality:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
20	Human Health:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM		MODERATE
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
21	Displacement of People:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
22	Loss of Historical and Cultural Sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
23	Employment Opportunities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
24	Increase in Local Population:	+VE	POSSIBLE	LONG TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	RATING
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
25	Increase in Local Economic Activities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
26	Loss of Social & Cultural Infrastructure:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
27	Boost to Local Industry	+VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
28	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
29	Threat to Human Health:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE

Table 7.4. Evaluation of potential environmental impacts: operation stage

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURRING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: DAM WALL AND SPILLWAY CONSTRUCTION								
1	Pollution due to increased usage of pesticides and fertilisers:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA & SURROUNDING ENVIRONS	LOW
2	Deterioration in Water quality in downstream reaches of the stream:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
3	Encroachment of aquatic weeds and water quality of the reservoirs:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
4	Public health:	-VE	POSSIBLE	MEDIUM TERM	IMMEDIATE	MEDIUM	PROJECT AREA	MODERATE
5	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURRING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: EQUIPMENT MOBILISATION AND OPERATION								
7	Erosion of the top soil and reservoir	-VE	CERTAIN	SHORT TERM	IMMEDIATE	MEDIUM	PROJECT AREA	HIGH
8	Soil and Water Pollution due to oil spills:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	LOW
9	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
10	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: BORROW PIT OPERATION AND MATERIAL HANDLING								
11	Reservoir sedimentation:	-VE	UNLIKELY	N/A	N/A	N/A		INSIGNIFICANT
12	Human Health:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: PRODUCTIVE AND SETTLEMENT LAND								
13	Increased Fish Production:	+VE	CERTAIN	MEDIUM TERM	NEAR FUTURE	HIGH	PROJECT AREA	HIGH
14	Dust Pollution	-VE	POSSIBLE	MEDIUM TERM	IMMEDIATE	MEDIUM	PROJECT AREA	MODERATE
15	Loss of Immovable Assets:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: DAM FILLING								
16	Deterioration in Water quality:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	BEYOND SURROUNDING ENVIRONS	HIGH
17	Change in Water quantity in downstream reaches:	+VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
18	Encroachment of aquatic weeds:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: CHANGE IN GROUNDWATER LEVEL AND QUALITY								
17	Increase in Groundwater level	+VE	CERTAIN	MEDIUM TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE
18	Deteriorating Groundwater quality	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: WASTE MANAGEMENT								
19	Threat to Human Health:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	LOW

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
21	Employment Opportunities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	BEYOND SURROUNDING ENVIRONS	HIGH
23	Boost to Economic Growth:	+VE	CERTAIN	LONG TERM	DISTANT FUTURE	MEDIUM	BEYOND SURROUNDING ENVIRONS	MODERATE
24	Increase in Local Population:	-VE	POSSIBLE	LONG TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE
25	Increase in Local Economic Activities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT
		POSITIVE OR NEGATIVE IMPACT	LIKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	RATING
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
26	Threat to Human Health:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
28	Break down in Social Cohesion:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
29	Loss of Immovable Assets:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
30	Disruption of livelihood:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

8. MITIGATION AND ENHANCEMENT MEASURES

A summary of mitigation and enhancement measures are outlined in Table 8.1 below.

Table 8.1. Summary of mitigation and enhancement measures

Potential Impact	Proposed Mitigation and Enhancement Measures
Increase in local population	Local people will be given priority in employment.
Loss of cultural and historical assets	No cultural and historical site is present at the site and therefore no loss is expected
Loss of productive land	No mitigation required since the land is arid
Noise pollution	Noise pollution will be limited to construction phase.
public health	Operation of the dam will be done in a manner that will disrupt disease vectors such malaria
Soil Erosion	Designate buffer zones between settlement and water front
Erosion at construction site	Reforestation will be adopted to rehabilitate exposed areas after construction. Limit heavy machinery to designated
Distortion of flow patterns and sediment loads of river	Use of recommended devices to be taken care of during design of the dam. Recommended operating regimes will be adopted.
Distortion in landscape	Minimum access roads will be constructed and borrow pits will be rehabilitated using excess earth and applying reforestation
Air pollution (dust),	Dust will be minimised by regularly watering of construction area.
Destruction of vegetation	Unnecessary vegetation clearing will be prohibited. Reforestate disturbed

	areas
Loss of vegetation, wildlife habitat	Prohibit unnecessary cutting of trees and vegetation clearing
Spread of aquatic weeds in reservoir	Controlled usage of agro-chemicals to limit nutrient loading to the reservoir thus limiting proliferation of weeds
Fish mortality	Clear vegetation prior to dam filling Allow natural fish restocking
Spread of disease vectors in impoundment	Disrupt disease vectors through controlled operations of reservoirs
Employment Opportunity	Give priority to local people
Economic growth	Effectively manage the irrigation scheme
Capacity Building	Conduct job on training
Change in river discharge	Observe Water Right regulatory requirements for downstream users and environment
Deterioration in water quality due to fertilizer use	control usage of agro-chemicals to standard
Increase in Sedimentation of	Buffer zones will be created and unnecessary tree cutting will not be permitted as this may lead to erosion enhancing

9. Environmental and Social Monitoring

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable response to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the ESMP.

Environmental monitoring is also carried out to ensure that all construction activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/environmental requirements. This person will maintain regular contact with National Irrigation Board Environmental Auditor and the local Sub-County Environmental Officers. The contractor and county have responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the pre-construction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment.

Monitoring includes:

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

Periodic on-going monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

Monitoring will be done in three fronts:

- Physical monitoring;
 - Biological monitoring ;and
 - Social monitoring.
-

9.1 Internal monitoring

It is the responsibility of the client to conduct regular internal monitoring of the project to verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the ESMP and construction contract clauses for the Project.

The monitoring should be a systematic evaluation of the activities of the operation in relation to the specified criteria of the condition of approval.

The objective of internal monitoring and audit will be:

- To find out any significant environmental hazards and their existing control systems in force.
- Meeting the legal requirements as stipulated in the Environmental Management & Coordination Act, EMCA-1999.

9.2 External monitoring and evaluation

The Consultant recommends that a consultant should be hired to carry out Annual Environmental Audits in line with NEMA requirements. NEMA has the overall responsibility for issuing approval for the Project and ensuring that their environmental guidelines are followed during Project implementation. Its 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.

The client through the consultant will therefore provide NEMA with reports on environmental compliance during implementation as part of their progress reports and annual environmental auditing reports. Depending on the implementation status of environmentally sensitive project activities, NEMA will perform annual environmental reviews in which environmental concerns raised by the project will be reviewed alongside project implementation.

Table 9.1. Brief environmental management plan

POTENTIAL IMPACT	MITIGATION MEASURE	OBJECTIVE	BY WHO	BY WHEN
Air and Noise Pollution from Construction and Waste Disposal	continuous watering of construction site to suppress dust, especially in areas where dust emitted is high Noise pollution will be limited to construction phase and confined to day time only	To minimize dust and noise disturbance	Site Engineer and Construction team	- At Commencement of dam Construction
Immigration to Construction Site	- Immigration to construction site would be limited to temporary workers involved in the work. No permanent structures would be allowed at the site	To reduce the pressure on local resources	- Recruitment Officer in conjunction with Project Manager	- At start of construction works
Loss of Cultural Sites and Historical Assets	- No cultural and historical site is present at the site and therefore, once any are discovered, NEMA will immediately be informed	To preserve cultural sites and articles of historical value	- Construction Team - Project Management	- At the start of sitting, construction and operation of the dam- on going

Table 9.2. Cont. brief environmental management plan

POTENTIAL IMPACT	MITIGATION MEASURE	OBJECTIVE	BY WHO	BY WHEN
Conflicting demand for water use, distortion of flow patterns and sediment loads of river	<ul style="list-style-type: none"> - use of recommended devices to be taken care of during design of dam - Planning and management of dams will be in context of existing laws and regulations 	<p>To maintain the minimum flow requirements</p> <p>Ensure equitable</p>	- Permits from Water Board	- After completion and approval of EIA by NEMA
Changes in water quality and sediment load	<ul style="list-style-type: none"> - Minimum flows will be maintained through dam design and control of usage of agro-chemicals - Sampling and testing of water in the dam for nutrients will be done at least biannually 	Ensure acceptable good water quality	- Operations Manager	- Six months after commissioning
Deterioration of Water Quality in Reservoir	<ul style="list-style-type: none"> - Clearance of vegetation from inundation zone prior to flooding - Control of land uses, wastewater discharges- though very limited or none at all - Controlled and effective agricultural chemical use in watershed 	To Maintain the water quality in the reservoir	- Construction team	- Prior to filling of the dam

Table 9.3. Cont. brief environmental management plan

POTENTIAL IMPACT	MITIGATION MEASURE	OBJECTIVE	BY WHO	BY WHEN
Decrease in flood plain (recession) agriculture	- Regulate releases from dam	to partially mimic natural flooding pattern	- Operation Manager	- On going during operation phase of project
Disruption of riverine fisheries due to changes in flow, blocking of fish migration	- Though not significant, the project will envisage provide fish ladders once identified fish passage and will provide spawning grounds protection - allow natural fish restocking in the reservoirs to compensate for fish loss	to maintain at least a minimum flow for fisheries. to maintain natural	- Project proponents - Operation Manager	- Once such fish has been identified
Increase in water related diseases	- Use standard designs and observe operational rules of the dams	To decrease habitat for vector Disease prophylaxis and treatment	- Project Manager	-On going during operation of dams
Increase in humidity and fog locally, creating favorable habitat for insect disease vectors (e.g. mosquitoes, tsetse)	- Employ disease vector control mechanism	To avoid proliferation of diseases	-Project proponents	-After completion and commissioning of the dam

Table 9.4. Cont. brief environment management plan

POTENTIAL IMPACT	MITIGATION MEASURE	OBJECTIVE	BY WHO	BY WHEN
Poor land use practices in Catchment areas above reservoir resulting in increased siltation and changes in water quality.	- -Buffer zone created to limit the distance of fields, e.g. Adhering to the Agricultural practices	To avoid siltation and sedimentation of water bodies	- Project Manager	- Before dam construction and after.
Environmental problems arising from development mode possible by dam.	-Apply basin –wide integrated planning.	to avoid overuse, misuse, and Conflicting uses of water	-operation Manager.	-Commencement of dam of dam.
Proliferation of aquatic weeds in reservoir and downstream Impairing dam discharge, Irrigation Systems, fisheries and Increasing water loss through	-Clearance of vegetation from inundation Zone prior to flooding, provide need control measure. -regulation of water discharge and manipulation of water levels.	Minimise (nutrient loading to minimise weed growth	-Operation manager. - Irrigation officer.	- during operation of the dam.
Soil Erosion	- Buffers would be developed and terracing will be implored were appropriate	to avoid soil erosion	- Construction team - Project manager	- During construction and operation stage

Table 9.5. Cont. brief environmental management plan

POTENTIAL IMPACT	MITIGATION MEASURE	OBJECTIVE	BY WHO	BY WHEN
Formation of sediment deposits at reservoir entrance creating backwaters effects, flooding and water logging up stream	- Sediment flushing and sluicing	To minimise sediment deposits	- Operation Manager	- On going during operation phase of project
Sedimentation of reservoirs and loss of storage capacity	- Control land use in watershed, prescribed distances of fields in relation to the dam - Hydraulic removal of sediment (flushing, sluicing, release of density currents)	To avoid loss of dam storage capacity	- Operation Manager	- On going during the operation of the dams
Loss of wildlife and wildlife habitat	- Undertake to vegetate disturbed areas	To Minimise loss of wildlife habitat	- Construction team - Project Manager	- Upon commencement of dam filling

10. CONCLUSION AND RECOMMENDATIONS

Conclusions

Overall, environmental impacts due to the project are deemed to be largely outweighed by the improved quality of life of the population through its implementation.

There are no priority forests, natural habitats, original species of vegetation and wildlife or historical or cultural heritage of significance that could be in danger as result of the project.

There are a few negative socio-economic impacts. However, there are various positive impacts such as the dam is likely to act as a tourist attraction both at the local and Regional levels considering the aesthetic land scape and act as a learning resource for institutions; additionally, the proposed resort will also help boost tourism.

Recommendation

Implementation: It is recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya at all times. In line with this, the proponent (National Irrigation Board) and the contractor must take the legislative framework provided in this report into consideration, during and after the implementation of the project, as will be appropriate.

Adherence to ESMP: In addressing the environmental issues, the contractor and/or the proponent must follow the mitigation guidelines provided under ESMP. This will ensure the Environmental and safety of operators and the neighbouring communities. It is also recommended that an Environmental and safety officer should be stationed in the proposed project site, during the whole construction phase. The safety officer will make sure that all the workers follow the safety rules.

Annual Environmental Monitoring and Audit: During Construction phase the Consultant and the Contractor is required to undertake Environmental Monitoring to ensure that the Construction is done in compliance with the provisions of the EIA License and during Operations the proponent should undertake an environmental audit (EA) of the project, as required by the NEMA. This will ensure that the project does not lose track of its good environmental management record achieved during construction. This can be done by seeking the services of an Environmental Consultants who should be Lead Experts registered by NEMA. The team should consist of the following experts as a minimum:

- Lead Environmental Consultant (Senior Environmentalist/Team leader)
- Associate Environmental Consultant
- Sociologist