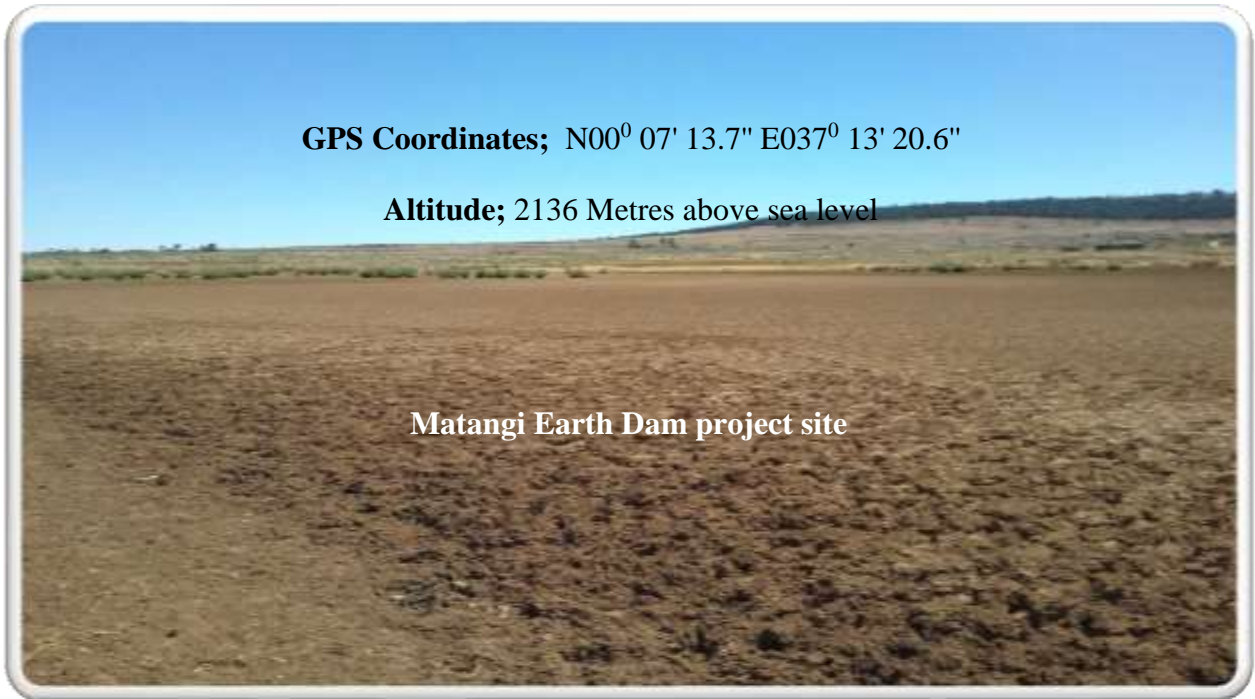


# ENVIRONMENTAL IMPACT ASSESSMENT

## PROJECT REPORT

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**PROPOSED MATANGI EARTH DAM REHABILITATION PROJECT WITHIN MATANGI VILLAGE IN  
CHUMBI SUB-LOCATION, ETHI LOCATION, LAIKIPIA NORTH SUB-COUNTY OF LAIKIPIA  
COUNTY**



© March 2019

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*This environmental Impact Assessment (EIA) Project report is submitted to National Environment Management Authority (NEMA) in conformity with the requirements of the Environmental Management and Coordination Act (EMCA), No. 8 of 1999 and the Environmental (Impact Assessment and Audit) regulation, 2003.*

### CERTIFICATION OF THE REPORT

This Environmental Impact Assessment (EIA) study for the proposed **Matangi earth dam** project within Laikipia North Sub-county of Laikipia County has been conducted and the report prepared with due diligence and professionalism as per Environmental Management and Coordination Act (EMCA) No. 8 of 1999 and Environmental Impact Assessment & Audit regulation of 2003, by approved and registered (by NEMA) EIA & EA Experts.

Table 1: EIA & EA firm of experts details

<b>NAME:</b>	<b>REGISTRATION STATUS:</b>	<b>NEMA REG. NO.</b>
Fredrick Karani Kirera  Signature.....  Date.....	Lead Expert	7442
Dickson Kimathi Muthaura  Signature.....  Date.....	Associate Expert	6235

### PROPONENT

I.....on behalf of **STATE DEPARTMENT OF AGRICULTURE – Kenya Climate Smart Agriculture Project (KCSAP)** confirm that this Environmental and Impact Assessment study report for the proposed **Matangi earth dam** project has been prepared and submitted to NEMA with our authority as the proponent.

Sign & Stamp..... Date.....

Designation.....

## EXECUTIVE SUMMARY

In pursuit of implementing environmentally sensitive development and enhancing provision of safe and adequate water for domestic and agricultural use, The Kenya Climate Smart Agriculture Project – KCSAP (herein referred to as the proponent) intends to initiate implementation of the proposed rehabilitation of Matangi Earth dam project with a purpose of not only to restore the dam and reservoir into their original condition, but also to upgrade the structure where possible.

Matangi earth dam covers an area of 6 acres and was constructed by the Mr. Gratton who sold the earth dam to the residents of Matangi through Laikipia East Farmers Society Company in the year 1981. The residents were able to obtain sufficient water from the earth dam for domestic and agricultural. However, the dam was later seriously degraded as a result of poor management. The dam was managed by the management committee comprising of subsistence farmers and pastoralists representatives. Currently, dam has been filled up with silt as a result of soil erosion from the catchment. The dam used to serve 150 households within Matangi village and Yumiririe village.

During public participation, the residents were very optimistic and positive that if the dam is rehabilitated, it will have several benefits to the residents of the area. Generally, the dam once it's rehabilitated and starts being in operation, it will greatly improve the socio-economic status of the residents of the area.

This Environmental Impact Assessment (EIA) study has been found necessary for the proposed earth dam project in order to incorporate environmental issues during construction and operation. Environmental Management and Co-ordination Act (EMCA), 1999 requires that all new projects undergo Environmental Impact Assessment (EIA) and a report submitted to National Environmental Management Authority (NEMA) for review and necessary approval before commencement. In pursuit, the proponent has ensured that the Environmental Impact Assessment (EIA) for the proposed earth dam project has been conducted before commencement of its implementation.

The proposed Matangi earth dam site is located within Matangi village in Chumbi Sub-location, Ethio location, Laikipia North Sub-County of Laikipia County at a GPS and altitude of **N00° 07' 13.7" E037° 13'20.6" and 2136 Metres above sea level** respectively.

The aim of this EIA project report is to identify the possible social, economic and environmental impacts that may arise from the construction and operations of this project and propose suitable mitigation measures in accordance with the Environmental Management and Coordination Act (EMCA) 1999 and Environmental Impacts Assessment & Audit Regulations, 2003.

EIA for such project is a requirement in Kenya under the Environmental Management and Coordination Act (EMCA) No.8 of 1999, which also outlines the general Terms of Reference (TOR). Other relevant legislations include the Water Act, 2016 which provides for the management, conservation, use and control of water resources. It also provides for the acquisition and regulation of rights to use water.

The Public Health Act which regulates activities detrimental to the human health; the Local government Act which grant's local authorities powers to control adverse development in their jurisdiction; and the Physical Planning Act and the Land Planning Act which make provisions for development control. The important standards controlling environmental quality are the national and those developed by the WHO (1993).

**Table 2: Summary of the main findings of the study**

<b>Impact</b>	<b>Impact Rating</b>	<b>Mitigation Measures</b>
Impacts on Soil and Land	Low	<ul style="list-style-type: none"><li>~ Ensure management of excavation/dredge activities.</li><li>~ Proper refilling of the excavated cuttings pit and power cables</li><li>~ Proper storage, handling and disposal of oil and oil wastes dredging and related construction.</li><li>~ Any maintenance of involved vehicles and other machines should be carried out in the contractor's yard off site or at a petrol station.</li></ul>

Impacts on Water Resources	Low	<ul style="list-style-type: none"> <li>~ Avoid entry of any undesirable material into the earth dam.</li> <li>~ Management of water usage to avoid unnecessary wastage of water.</li> </ul>
Impacts on Biodiversity	Low	<ul style="list-style-type: none"> <li>~ Proper storage, handling and disposal wastes during dredging and related construction.</li> <li>~ Restrict activities to the proposed site.</li> <li>~ Any maintenance of involved vehicles and machinery should be carried out in the contractor's yard off site.</li> </ul>
Socio-Economic Impacts	High- Positive	<ul style="list-style-type: none"> <li>~ Reliable source of water for domestic and agricultural use.</li> <li>~ Minimize occurrence of water-borne diseases.</li> <li>~ Reduction of distance travelled in search of water.</li> <li>~ Improved household and community income generating activities.</li> <li>~ Increased participation of women in socio-economic development</li> <li>~ Promote economic growth of the area.</li> </ul>
Impacts on Air Quality	Low	<ul style="list-style-type: none"> <li>~ Ensure proper working conditions of exhaust systems of the earth dam dredging and construction machines.</li> <li>~ Provide dust masks for dredging and construction crew.</li> <li>~ Water stockpiles of earth to minimize dust emission.</li> </ul>

Impacts on public health and safety	Potentially	<ul style="list-style-type: none"> <li>~ Provide proper protective gears to all workers.</li> <li>~ All project participants should have insurance and workmen's compensation.</li> <li>~ There should be a standby vehicle in case of any medical emergency.</li> <li>~ There should be presence of full-equipped first aid kit at site.</li> <li>~ Ensure the availability of Emergency contacts for police and ambulance service provider.</li> <li>~ Emergency plans should be communicated and well understood.</li> <li>~ Warning signs and electrical safety should be properly displayed and observed.</li> </ul>
Conflicts over water use	Low	<ul style="list-style-type: none"> <li>~ Formation of Conflict Management and resolution committee.</li> </ul>
Visual impact	Low	<ul style="list-style-type: none"> <li>~ Minimal.</li> </ul>
Vandalism	Low	<ul style="list-style-type: none"> <li>~ Employ security guard.</li> <li>~ Fence the site and install appropriate gate.</li> </ul>

### **Conclusion and recommendation**

The study concludes that the proposed Matangi earth dam will not have significant adverse environmental impacts, and thus the project should be allowed to proceed. However, it is important that the mitigation and monitoring measures recommended in the report are strictly and appropriately implemented. The proposed project will have immense socio-economic and health impacts that include supply of adequate water to the residents of the area for domestic and agricultural use. It is thus the experts' recommendation that the proponent be issued with EIA license so that they can commence the implementation of the proposed project.

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## **ACRONYMS**

<b>a.s.l</b>	~ Above Sea Level
<b>EIA</b>	~ Environmental Impact Assessment
<b>EMCA</b>	~ Environmental Impact Assessment
<b>NEAP</b>	~ National Environmental Action Plan
<b>NEMA</b>	~ National Environmental Management Authority
<b>TDS</b>	~ Total dissolved Solids
<b>TOR</b>	~ Terms of Reference
<b>UN</b>	~ United Nations
<b>UNEP</b>	~ United Nation Environmental Programme
<b>UNCEF</b>	~ United Nations Children Fund
<b>WHO</b>	~ World Health Organization
<b>WRM</b>	~ Water Resource Management
<b>WRMA</b>	~ Water Resource Management Authority

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background Information**

Environmental Impact Assessment (EIA) is a formal process used to predict the environmental consequences both positive and negative of a plan, policy, program, or project prior to the decision to move forward with the proposed action. This EIA project report for the proposed Matangi earth dam project provides current, accurate, relevant and adequate information vis-à-vis the proposed project.

Matangi earth dam covers an area of 6 acres and was constructed by the Mr. Gratton who sold the earth dam to the residents of Matangi through Laikipia East Farmers Society Company in the year 1981. The residents were able to obtain sufficient water from the earth dam for domestic and agricultural. However, the dam was later seriously degraded as a result of poor management. The dam was managed by the management committee comprising of subsistence farmers and pastoralists representatives. Currently, dam has been filled up with silt as a result of soil erosion from the catchment. The dam used to serve 150 households within Matangi village and Yumiririe village.

Currently, only small section of the earth dam downwards collect rain water from runoff from the surrounding area which is not enough and dries immediately within a short period of dry spell. During public participation, the residents were very optimistic that if the dam is rehabilitated, it will have immense benefits to the residents of the area. Generally, the dam once it's rehabilitated and start being in operation, it will greatly improve the socio-economic status of the residents of the area.

The proponent intends to seek approval from NEMA for rehabilitating Matangi earth dam with an aim of addressing the problem of acute water shortage within Ngiiy village and its environs. The water will be utilised for domestic use and agricultural purpose.

This Environmental Impact Assessment Project Report has been conducted as per Environmental Management and Coordination Act (1999) and the Water Act 2016 which makes it mandatory that such a project undergoes Environmental Impact Assessment (EIA). The Terms of Reference are as per the Environmental (Impact and Audit) Regulations Legal Notice 101 (2003). The EIA project report seeks to identify in a structured and systematic manner the possible consequences, positive or negative, of the proposed project on the environment, to determine those which are deemed significant, and to present appropriate

mitigation measures to avoid or reduce the adverse impacts of those that are negative to acceptable levels and maximize the positive impacts.

## **1.2 Terms of Reference, objectives and scope of study**

### **1.2.1 Terms of Reference**

Because there were no defined Terms of Reference (TOR) between the consultant and the proponent, the consultant deemed it fit to adopt the TOR5 as per the guidelines to conducting an EIA Project Report in accordance with the Environmental (Impact and Audit) Regulations Legal Notice 101 (2003).

Accordingly, the present EIA project report will:

- a) Describe the nature of the project and its design;
- b) Detail the materials to be used, products and by-products, including waste to be generated by the project and the methods of their disposal;
- c) the activities that shall be undertaken during the project construction, operation, commissioning and/or decommissioning phases;
- d) Give the location of the project including the physical area that may be affected by the project's activities;
- e) Evaluate the relevant legislative framework;
- f) Evaluate the potential environmental impacts of the project and the mitigation measures to be taken during and after implementation of the project;
- g) Provide an elaborate Environmental Management Plan which will enforce the recommended mitigation measures against any negative environmental impact brought about by the project;
- h) Any other information the Authority may consider necessary.

### **1.2.2 Objectives and scope of study**

The aim of this assessment was to identify significant potential impacts of the proposed project to environment and social aspects and formulate recommendations to ensure that the project takes into consideration appropriate measures to mitigate any likely adverse impacts to the environment and the people's health through all phases of its implementation.

**The specific objectives are:**

- a) To present an outline of the background of the proposed project;
- b) To review existing legal and institutional policy framework related to the proposed project;
- c) To establish the environmental baseline conditions of the project area and review all available information and data related to the proposed project;
- d) To identify key areas for environmental, social and safety concerns as well as the anticipated impacts associated with the proposed project implementation and commissioning;
- e) To predict likely environmental and social impacts of the proposed project;
- f) To establish a comprehensive environmental and social and management plan covering the construction, operation and decommissioning phases of the proposed project;
- g) To raise community awareness on the impacts of the proposed project on the environment;
- h) To highlight environmental issues with a view to guide policy makers, planners, stakeholders and the government agencies to help them understand the implications of the ESIA report and make the necessary decisions concerning the proposed project and future planning;
- i) To establish benchmarks for the various environmental aspects relating to the proposed project;
- j) To establish a framework for environmental management system that aims at environmental sustainability;
- k) To prepare a comprehensive project report in accordance with the environmental legislation and submission to NEMA for further instruction and /or approval.

### **1.3 Methodology Outline**

The general procedure outline applied in this EIA process involved the following steps:

#### **1.3.1 Screening and Scoping Stages**

Screening was carried out to determine whether an EIA was required in accordance with schedule 2 of EMCA, 1999 and the Environmental (Impact and Audit) Assessment Regulation Legal Notice 101 of 2003. The project was found to qualify for a project report.

Scoping was undertaken to decide on the critical issues of focus during the assessment. This stage mainly involved review of relevant data and identification possible area of impacts and recipients, project alternatives methodologies relevant to the project, as well as who to consult. Accordingly, existing data including Matangi earth dam records, geological maps and reports and any other relevant information were reviewed. The identified issues were scrutinized against the available data.

### **1.3.2 Fieldwork and Impact assessment Stage**

A site visit to the project area was carried out on 1<sup>st</sup> March, 2019 to assess the existing water supply situation with respect to demand, current land uses and the general set up of the Matangi earth dam to be rehabilitated. Alternative water sources were evaluated, the findings of which are included in this report.

The baseline information acquired during the scoping stage was fine-tuned and verified. The Key impacts relevant to this project were identified during this stage and include:

- ~ Impacts on Soil and Land;
- ~ Impacts Water Resources;
- ~ Impacts on Biodiversity;
- ~ Socio - Economic Impacts;
- ~ Impacts on Air Quality;
- ~ Impacts on Public Health and safety;
- ~ Conflicts over water use;

### **1.3.3 Environmental Management Planning Stage**

Based on the impacts identified, recommendations on appropriate mitigation measures were drawn through discussion, experiences from past similar projects, assessment of land-use and social compatibility and socio-economic factors. As part of the mitigation measures, an outline of Environmental Management Plan (EMP) was developed. The EMP presents the key environmental aspects, appropriate action plans, responsibilities, time frames and monitoring indicators.

#### **1.3.4 Public Participation**

Public participation forms an important part of this report. The public participation was accomplished through administration of a well-designed and pre-tested questionnaires and key informant. The views of the stakeholders were also obtained through Focused Group Discussion (FGD).

The aim of the public participation was to acquire history of the earth dam, create awareness to the community on the proposed earth dam rehabilitation project, the anticipated environmental and social impacts of the proposed earth dam rehabilitation project as well as seek their opinions and concerns in regard to the same. The results are presented in this report.

The interviewees indicated that the proposed project will have positive impacts to the residents by providing water for domestic use and agricultural use. They also pointed out that the proposed project will enhance food security, improve livestock health and generally improve economic status of the residents. However, there were no major negative impacts underscored by the participants. *Copies of questionnaires and list of participants are annexed.*



## **CHAPTER TWO: DESCRIPTION OF THE EARTH DAM REHABILITATION PROCESS AND PROPOSED ALTERNATIVES**

### **2.1. Introduction**

The aim of rehabilitation works to be carried out on Matangi earth dams is not only to restore the dam and reservoir into their original condition, but also to upgrade the structure where possible.

The process will ensure that the structures selected for rehabilitation will guarantee that the costs involved will yield the maximum benefits, and where a reasonable chance exists that climatological, agro-ecological and community involvement factors are such that after rehabilitation, the dam will have a useful lifetime in line with set expectations.

On the technical/economical side, the rehabilitation process will keep in mind that physical removal of sediment deposits using ordinary earth-moving methods is rarely feasible. It is nearly always more interesting to either raise an existing embankment where the topography allows, or otherwise construct a new dam downstream of the old silted reservoir, whereby the old reservoir will further act as a silt-trap. Removal of sediments by scooping provides a ratio (water storage volume / earth fill volume) of 1, where even a dam-site rated as poor will have a ratio of 3. Physical removal of silt does make sense on sites where the sediments removed can be used to widen and raise the embankment crest and where significant ancillary structures have been built around the existing dam.

Another important factor which will be assessed before rehabilitation works are decided upon is the agro-ecological situation, the erosion and the expected sediment yield of the catchment area.

Finally the potential for successfully involving the beneficiaries not only in a number of construction activities but particularly in operation and maintenance of the structure and their willingness to make long term investments in catchment improvement and protection works, is another factor which will be taken seriously into consideration.

## **2.2. Analysis of the cause of failure**

Prior to rehabilitation process commencement, a careful analysis will be made to establish the cause of the failure or condition that has necessitated the rehabilitation. This may require a number of steps including:

- ~ Interrogating any locals or witnesses to the event that caused damage;
- ~ Obtaining original design or as-built drawings and reports;
- ~ Obtaining photographs of the as-constructed structure;
- ~ Obtaining rainfall and stream flow records for the event that caused damage;
- ~ Conducting topographical surveys to ascertain high water marks with respect to spillway and crest levels. This can help to ascertain whether overtopping of the embankment occurred;
- ~ Conducting topographical surveys to establish whether excessive embankment settlement took place. Observations of longitudinal cracks on the embankment could also signify slumping and slope failure;
- ~ Soil sampling and analysis to establish embankment material which may be different to surrounding soils and may be different across the cross section of the embankment.

The cause of failure analysis is important to avoid investing in the rehabilitation of a structure that has a fundamental weakness that is difficult or expensive to overcome (e.g. no impervious core resulting in excessive seepage, embankment built out of dispersive soils). In addition, if the failure is caused by insufficient attention to operation and maintenance tasks, then a substantive review of the O & M schedule and those responsible should be undertaken. In many instances, the cause of failure is not immediately obvious and may be attributed to a number of different factors taking place in combination.

Once there is sufficient confidence that the cause of the failure or damage has been established, then efforts to design the rehabilitation works can commence.

## **2.3 Rehabilitation Works**

The rehabilitation works must address the cause of failure as well as returning the structure to operational status.

### **2.3.1 Embankment Repairs**

All trees and vegetation will be removed from the old (possibly eroded) embankment, after which the embankment will be trimmed down (min. 0.30 m). Any loose material will be removed or stockpiled for reuse. The trimmed old embankment is used as an upstream core for the construction of the new embankment. Suitable soil will be used for the fill, and the usual compaction procedures will followed. The core-trench will be incorporated in the new embankment. Care will be taken to ensure a good contact between the old and new sections of the embankment, and between the foundation and new material.

At the same time, various other works to improve the embankment will be carried out if required, such as:

- ~ Rip-rap protection on upstream slope;
- ~ Incorporation of a filter blanket and toe drain etc.

Raising of an embankment will normally require the filling of the old spillway channel and the construction of a new spillway. Alternatively, the concrete spillway sill can be raised and erosion protection provided downstream of the sill.

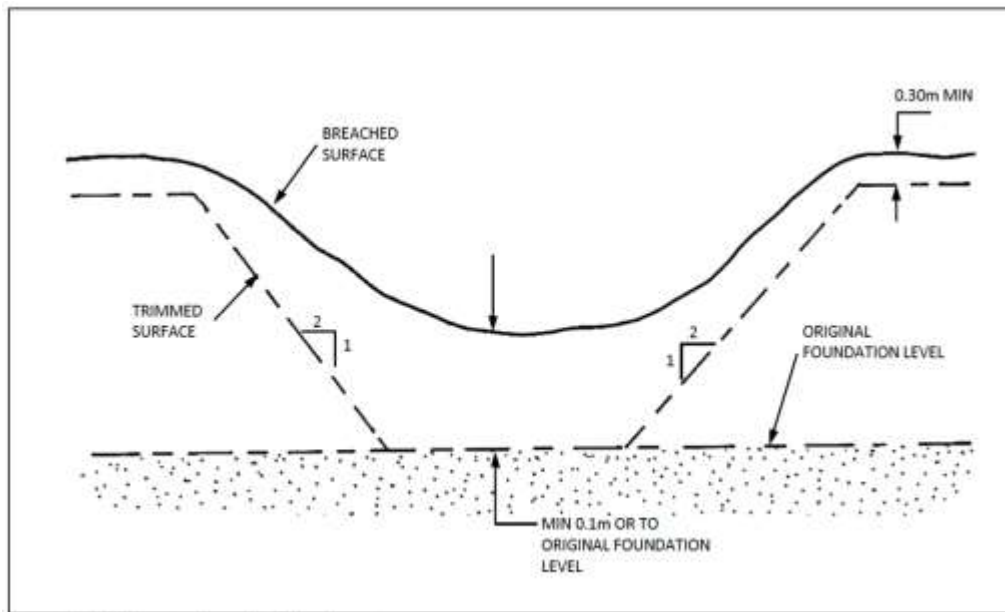


Figure 1: Trimming a breached embankment

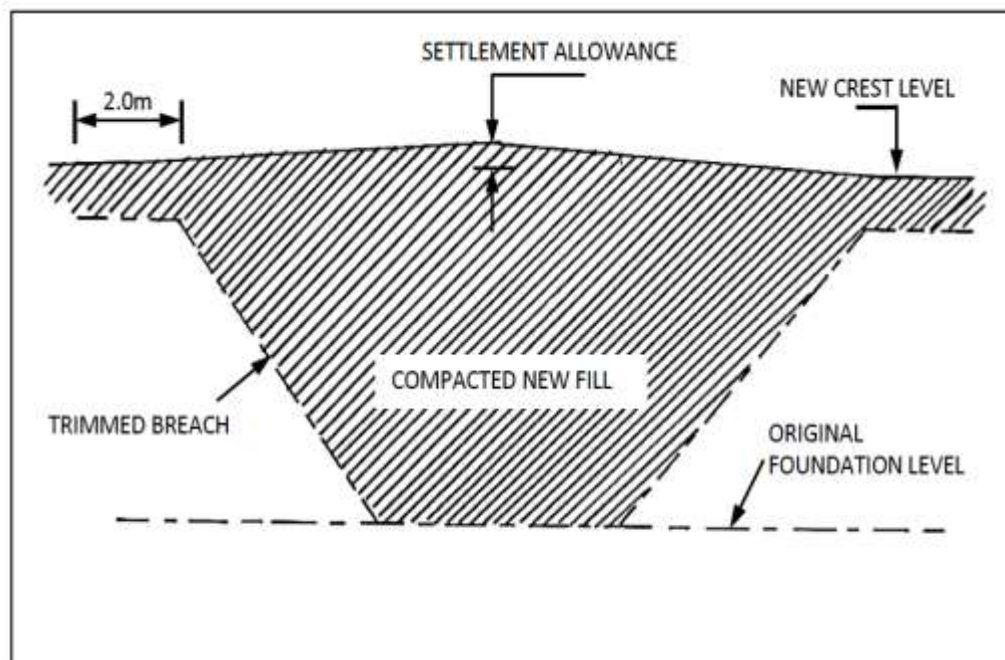


Figure 2: Repair of a breached embankment

### 2.3.2 De-silting

Prior to de-silting any reservoir by mechanical means, it must be emptied if it contains water. This can be done by either pumping or cutting part of the spillway channel to the required depth. Breaching of the embankment is not recommended. The digging of a number of test

pits in the reservoir, in order to establish the depth of the silt layer, prior to the scooping is will be done. This will also permit study of the stratification of the silt layer, which might eventually lead to determining its origin within the catchment.

If de-silting happen to be conducted by traditional earth-moving methods, the most effective way will be use of a bulldozer (100-125 kW will generally be suitable) for the removing the silt, a wheel loader for loading it and tipping lorries for the transport of the silt. This basic machinery will be assisted by a number of smaller machines to perform more specific tasks. If the removed soil is judged suitable, it will be re-used for repairing the embankment.

### **2.3.3 Spillway Repairs**

Repairs of old (eroded) spillways will usually involve the construction (or rehabilitation) of sills, lining eroded stretches with rip-rap (at least 0.30 m thick and compacted by a dozer), and stabilization of banks by the use of gabions.

The original spillway design calculations will be confirmed and revised if needed due to changing catchment conditions or improved data on stream flow or rainfall.

### **2.4 Project Budget**

The proposed project will cost **Eight Million, six hundred and seventy nine thousands, nine hundred and ninety Kenyan Shillings (8,679,990)**. See attached copy of Bill of Quantity.

### **2.5 Alternatives to the proposed Project**

It is a requirement that during the EIA process, alternatives to the project including water sources, site and rehabilitation technology be considered. The alternatives given here below:

#### **2.5.1 Alternative Water Sources**

A number of water source alternatives have been considered and are listed here below:

- 1) **Roof Catchment;** This would be an alternative among others but this source however is reliable during rainy seasons only and not there during dry spells and also cannot meet clients demand. In addition, the residents' houses have small iron sheet roof which cannot harvest enough rain water.

- 2) **River water.** This is not a feasible alternative based on the fact that the nearest river (Timau river) is far from Nganyii village and the water from the river is not sufficient especially during dry spell.
- 3) **Borehole.** This would not be an ideal alternative because the ground water level is very high. The borehole drilling is recommended in the areas where the water table is very low.
- 4) **Matangi earth dam Water;** this is the only viable option. The proponent has put into place the necessary strategies and is mobilizing the required resources to commence rehabilitation of the Matangi earth dam.

### **2.5.2 Alternative Site**

There are a number of scenarios that have led to consideration of an alternative Matangi earth dam site. These may include existence of the dam which can be rehabilitated and the willingness of the residents of Nganyii village. This other reason is the fact that the site is within the project area and the residents are suffering from acute water shortage for domestic and agricultural use.

### **2.5.3 Rehabilitation Technology**

The rehabilitation process will be undertaken using the modern machinery and technology and this will be involved in all the activities of repairing embankment and spillway and de-silting.

### **2.5.4 'No Action' Alternative**

No Action Alternative implies that the rehabilitation of the earth dam will not take place. This is highly undesirable because the present project will immensely benefit the residents of Matangi and Yumiririe village and the surrounding area. If the status quo is maintained, the residents will continue to suffer from acute water shortage. The 'No Action' alternative is therefore ruled out.

## **CHAPTER THREE: PROJECT LOCATION AND ENVIRONMENTAL SET UP**

### **3.1 The Site Location**

The proposed Matangi earth dam site is located within Matangi village in Chumbi Sub-location, Ethio location, Laikipia North Sub-County of Laikipia County at a GPS and altitude of **N00° 07' 13.7" E037° 13'20.6" and 2136 Metres above sea level** respectively.



**Figure 3: Matangi earth dam site**

### **3.2 Physical and Topographic Features**

The altitude of Laikipia County varies between 1,500 m above sea level at Ewaso Nyiro basin in the North to a maximum of 2,611 m above sea level around Marmanet forest. The other areas of high altitude include Mukogodo and Ol Daiga Forests in the eastern part of the county at 2,200 m above sea level. The County consists mainly of a plateau bordered by the Great Rift Valley to the West, the Aberdares mountain ridge to the South and Mt. Kenya to the South East.

The main drainage feature is Ewaso Nyiro North basin with its tributaries having their sources in the slopes of the Aberdares and Mt. Kenya. These tributaries include Nanyuki, Timau, Rongai, Burguret, Segera, Naromoru, Engare, Moyok, Ewaso Narok, Pesi and Ngobit rivers. The flow of these rivers matches the County's topography, which slopes gently from the highlands in the South to the lowlands in the North. The rivers determine to a large

extent livelihood patterns in the county. In addition, there are two major swamps in the county namely; Marura Swamp which runs along the Moyot valley in Ol-Pajeta Ranch and the Ewaso Narok Swamp around Rumuruti town.

The Southwestern part of the county has the highest potential for forestry and mixed farming due to its favourable climatic conditions. The eastern and northern parts of the county are suitable for grazing while the plateau lying in the central and the northern parts of the county is suitable for ranching. The swamps have some agricultural potential but require adequate management. Encroachment for human settlement and agricultural production poses serious threat to their existence.

### **3.3 Ecological Conditions**

Laikipia County is endowed with pastureland, rangeland, forests, wildlife, undulating landscapes and rivers among others. The high and medium potential land, which is suitable for crop farming, constitutes 20.5 per cent of the total county's land area. The remaining 79.5 per cent is low potential and suitable for livestock and wildlife. The major soils in the county are mainly loam, sand and clay. Black cotton soil, which has inherent fertility, spreads in most parts of the plateau. The dark reddish brown to red friable soils and rocky soils are mainly found on the hillsides.

The county has a gazetted forest area totalling to 580 Km<sup>2</sup> comprising of both the indigenous and plantation forests. The indigenous forests include Mukogodo and Rumuruti while plantation forests include Marmanet and Shamaneik. Laikipia County is richly endowed with wildlife widely distributed in most parts of the county extending to Aberdare, Samburu, Meru and Mt. Kenya wildlife corridors. Most of the wildlife is found in the large-scale private ranches, which occupy over 50 per cent of the total area of the county. The rest are found in group ranches predominantly owned by the Maasai, in the gazetted forests of Mukogodo, Rumuruti and Marmanet and other uninhabited tracts of land in the county.

### **3.5 Climatic Conditions**

The county experiences a relief type of rainfall due to its altitude and location. The annual average rainfall varies between 400mm and 750mm. The areas nearest to the slopes of Mt. Kenya and the Aberdare Ranges record higher annual rainfall totals. North Marmanet receives over 900mm of rainfall annually; while the drier parts of Mukogodo and Rumuruti



receive slightly over 400mm annually. The Laikipia plateau receives about 500mm of rain annually, while Mukogodo Forest receives an average rainfall of about 706mm annually.

Due to its location along the equator and proximity to Mount Kenya, the county experiences a cool temperate climate, with mean annual temperatures of between 16°C and 26°C. Most of the residents in Laikipia North are pastoralists who move from one area to another in search of water and pasture when the area gets too dry.

### **3.6 Topography**

The land is generally flat with an average slope of 0 - 5%. Steep slopes are encountered at the banks of rivers and water ways. Water way floors have a general slope of 0.5%. The land terrain is suited for irrigation development.

### **3.7 Soils**

The soils vary from sandy loams to clay loams. Thus, pans for storing rainfall run-off must not have to be lined if they have to keep the water for a long duration of time.

### **3.8 Hydrology**

There are no river draining in the area except for seasonal spring from a series of dams . However, run-off from the higher ground has formed wide shallow water ways. These water ways supply water to some of the water storage structures. Thus, there is a high potential for run-off harvesting.

## **CHAPTER FOUR: LEGISLATIVE AND REGULATORY CONSIDERATIONS**

The framework for the sustainable management and protection of the environment is provided by the Environmental Management and Coordination Act (1999) while the framework for the protection of water resources is provided by the Water Act 2016 which replaced Water Act 2002. The EIA process is currently guided by the regulations promulgated in terms of the Environmental (Impact Assessment and Audit) Regulations Act, 2003. Others are relevant acts are those that regulate development such as Urban Planning Act of 1996 and Public health and safety (Public Health Act, 242). The relevance of each of these acts to the proposed project is highlighted in this chapter.

### **4.1 General Regulatory Framework for EIA**

The Environmental Management and Co-ordination Act, 1999 (EMCA), underscores the general principles, which entitle every Kenyan to a clean and a healthy environment. This act has the overall responsibility of establishing national environmental principles and to provide guidance and coherence to sound environmental management. It further deals with cross-sectoral issues such as overall policy formulation, environmental planning, protection and conservation of the environment, environmental impact assessment, environmental audit and monitoring, environmental quality standards, environmental protection orders, institutional coordination and conflict resolution.

The Environmental (Impact Assessment and Audit) Regulations Act, 2003 stipulates the process of EIA and Environmental Audit and Monitoring. Section 58 of EMCA makes it a requirement for environmental impact assessments of projects and activities out of character with their natural surroundings to be carried out. Within this provision, an environmental monitoring programme comes one of the principal components of EIA recommendations against which crucial management decisions would be made.

EMCA established the National Environment Management Authority (NEMA) that is mandated to coordinate all environment issues, the lead agency for water resources management the Water Resource Authority (WRA) established under part III, section I of the Water Act 2002.

## **4.2 Regulatory Enforcement**

EMCA enhances penalties for environmental offences and provides for appointment of environmental inspectors. These two provisions are expected to improve environmental responsibility and governance amongst Kenyans, both as private citizens, and/or as players in the private and public sectors. EMCA gives strength to the Water Act 2016 and ensures a more environmentally sustainable approach to protect and conserve water resources, especially when the Polluter Pays Principle is applied as underscored under the Water Act 2016. This act also regulates water abstraction activities for both surface and groundwater.

## **4.3 Environmental Quality and Discharges to Surface Water and Land Surface**

Regulations and standards for environmental quality have been enshrined in the Environmental Management and Coordination Act, 1999. Part VIII of the Act refers to Environmental Quality Standards with relevant sections on pollution of water and air. It also addresses standards for waste, noise, radiation, and noxious gases. Although EMCA addresses needs for various environmental standards, the setting of national effluent standards is a primary responsibility of the Ministry of Environment and Natural Resources through the Water Act 2016, supported by the Public Health Act (Cap 242). The Penal Code, Section 191 makes it a crime the act of discharging noxious liquids and gases into the environment.

## **4.4 Health and Safety**

To safeguard public health and safety, World Health Organization and EU drinking water quality standards are widely used to determine portability of water. National standards for water and effluent quality will be governed by the regulations and provisions in the Water Act 2016 and Public Health Act (242), under guidelines of the new framework legislation.

The Public Health Act regulates activities detrimental to the human health. Part IX, section 115 of the Act states that no person or proponent's sites shall cause nuisance or conditions liable to be injurious or dangerous to human health.

Section 116 requires Local authorities to take all lawful, necessary and reasonable practicable measures to maintain areas under their jurisdiction clean and sanitary to prevent occurrences of nuisance or conditions liable for injurious or dangerous to human health. The owner(s) of the premises responsible for environmental nuisance such as noise and air emissions at levels that can affect human health are liable to prosecution under this act.

#### **4.5 Land Use Control**

Land use control is enforced through the Agriculture Act (Cap 318), the Land Act (Cap 300), Land Control Act (Cap 302), the Physical Planning Act of 1996, and EMCA under Part V on the Protection and Conservation of the Environment. Although the Physical Planning Act does not specifically mention earth dam rehabilitation activity, it is intended to reduce potential conflicts between the interest of the authorities and those of landowners in respect of settlement, social and economic activities.

#### **4.6 Public Responsibility and Participation**

Part XIII (Sections 140, 142, 143 and 145) of EMCA touches on Environmental Offences relating to standards, pollution, restoration orders, easements and conservation orders. These sections spell out penalties for the various categories of environmental offences and give the public powers (ref. Locus stand) to sue environmental offenders and/or seek redress through courts of law. Legal suits could be filed against individual offenders, bodies corporate, partnerships, principals or employers.

#### **4.7 Water Act, 2016**

Part II, section 5 states that every water resource is vested in and held by the national government in trust for the people of Kenya. Part III, section 29 states that Water Resources Users Associations (WRUAs) may be established as associations of water resource users at the sub-basin level in accordance with Regulations prescribed by Water Resources Authority. Section 30 (1) establishes the National Water Harvesting and Storage Authority.

#### **4.8 The Penal Code, Cap.63**

The Act makes it an offence for any person or institution that voluntarily corrupts or fouls water public springs or reservoirs, rendering it less fit for its ordinary use guilty of an offence. It is also an offence to make or vitiate the atmosphere in any place to make it noxious to health of persons / institution in dwellings or business premises in the neighborhood or those passing along a public way.

#### **4.9 EMC (Waste Management) Regulations, 2006**

This regulation defines the responsibilities of waste generators and the duties and requirements for transportation and disposal of waste. It states that “ no person shall dispose

of any waste on public highway, street, road, recreation area or in any public place except in a designated receptacle and a waste generator shall collect, segregate and dispose such waste in the manner provide for under these regulations”. It provides for mitigation of pollution and provides for hazardous and toxic wastes.

#### **4.10 Work Injury Benefits Act, 2007**

This is an Act of Parliament to provide for compensation to employees for work related injuries and diseases contracted in the course of their employment and for connected purposes. An employee is a person who has been employed for wages or a salary under a contract and includes apprentice or indentured learner.

#### **4.11 Occupational Safety and Health Act 2007 (OSHA 2007)**

The standards and requirements to be maintained during construction are specified under the Factories (Building Operations and Works of Engineering Construction) Rules 1984. However this Act was repealed by the OSHA, 2007. The OSHA, 2007 is more inclusive and is an Act of Parliament to provide safety, health and welfare of the workers and all persons lawfully present at workplaces and to provide for the establishments of the National Council for Occupational safety and health and for all connected purpose.

Part I section 3 (1) states that; “the Act shall apply to all workplaces where any person is at work, whether temporarily or permanently.

Part II states that “the purpose of the Act is to secure safety, health and welfare of persons at work and protect persons other than persons at work against risks to safety and health arising out of work, or in connection with, the activities of persons at work”. Part 11 section 6 (1-6) provides for what occupiers of premises ought to do to ensure the safety, health and welfare at work of all persons working there. Section 7 spells out the duties of the occupier being preparation of safety and health policy statement.

Section 13 (1a-e) provides for the duties of the employee while at work place while section 14 to 16 highlights the duty to report any dangerous situation, duty not to interfere with or misuse things provided pursuant to certain provisions and the prohibition against creation of hazardous situations. The offences committed are also highlighted and clearly spelt out.

Sections 21-22 provide what occupier is out to do to notify the occupation Health and Safety (OHS) officer of cases of accidents and dangerous occurrences and occupational diseases.

This act requires developers of facilities to notify the Director of OHS of their plans before the developments start. This Act also sets minimum standards that are to be maintained in such work places to safeguard health, safety and welfare of the workers. This action aims at eliminating hazardous situation at work places. The act further makes it mandatory for occupiers or employers to provide personal protective equipment (PPE) and all practicable means to prevent injury to workers who are exposed to potentially harmful substances and conditions. This Act applies mostly during drilling and installation of the pumping facilities.

#### **4.12 EMC (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009**

The Act is conferred by section 147 of EMCA 1999. Part II section (5) states that “no person shall make, continue or cause to be made or continued any noise in excess of the noise levels set in the First schedule, unless it’s necessary to the preservation of life, health, safety or property”. Section (6) (1 and 2) ensures that no person shall cause noise from any source which exceeds any sound level as set out in the regulations and measurements shall be taken by the relevant lead agency.

Sub section (5) states that “any person who makes noise in excess of the prescribed levels commits an offence”. Section 7 (a-d) exempts noise emitted during alerting, performance or noise in connection with the protection of the health and safety of residents or their property during emergency conditions and or warning devices necessary for the protection of public safety.

Part III section II (1) (b) states that any person wishing to engage in any commercial or industrial activity which is likely to emit noise or excessive vibrations shall carry out the activity or activities within the relevant levels prescribed in the First schedule.

Section 15 states that any person intending to carry out construction, demolition, mining or quarrying work shall, during the Environmental Impact Assessment studies.

- (a) Identify natural resources, land uses or activities which may be affected by noise or excessive vibrations from the construction, demolition, mining or quarrying;

- (b) Determine the measures which are needed in the plans specifications to minimize or eliminate adverse construction, demolition, mining or quarrying noise or vibration impacts; and
- (c) Incorporate the needed abatement measures in the plans and specifications.

#### **4.13 EMC (Water Quality) Regulation, 2006**

These regulations are applicable to drinking water, water used for industrial purposes, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife, and water used for any other purposes. The regulations provide that every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution and it shall immaterial whether or not the water resource was polluted before the enactment of these regulations. It also provides that no person shall discharge effluent from sewage treatment works industry or other point sources without a valid effluent discharge license issued in accordance with the provisions of the Act.

## **CHAPTER FIVE: PUBLIC PARTICIPATION**

Public participation is an integral part of EIA in accordance with EMCA, 1999. It is usually conducted to gauge whether the project in its present design is acceptable by the local community, and aid the proponent/contractor to incorporate in within the environmental management plan, the concerns of the members of the public who could potentially be affected.

### **5.1 Sources of Information**

The views of the residents were gathered on 1<sup>st</sup> March 2019 through the use of well-structured and pre-tested questionnaires and Focused Group Discussion. These questionnaires were submitted and later collected for analysis. In addition, all the residents in the surroundings were informed of the proposed project. The various issues of importance that were raised are presented herein. *See attached copies of questionnaires and list of participants.*

### **5.2. Awareness of the proposed project or similar project in the area**

Some of neighbors were aware of the proposed Matangi earth dam rehabilitation. Those neighbors, who were not aware of the impending proposed project, were duly informed verbally, and through the questionnaires.

### **5.3 Project effects on the surroundings**

All the interviewees do not expect the project to have significant impacts on the surrounding. There is however need to inform them of the possible impacts and the mitigation measures to be undertaken before the rehabilitation process commences.

### **5.4 Objection to the proposed project**

There was no objection to the project. Members of the public were actually pleased with the fact that the proponent was intending to rehabilitate Matangi earth dam to supply them with water for domestic and agricultural use. They pointed out that the proposed project will provide them with water for domestic and agricultural use, improve food security, increase livestock production and generally improve the economic status of the residents of the area.





**Figure 4: Public participation meeting**

## **CHAPTER SIX: IDENTIFICATION OF IMPACTS AND PROPOSED MITIGATION MEASURES**

### **6.1 Introduction**

This section entails impacts that may arise during implementation of the proposed project. Most of these key issues were identified during the scoping exercise and are clearly elaborated as follow:

### **6.2 Impacts on Water Resources**

The amount of water potentially available will only be accurately determined after completion of the rehabilitation process and rain water is harvested. The water will be harvested from the surrounding land and stored in the reservoir (dam).

The project is not expected to have any impact on the surface water since no major rivers or streams are present in the vicinity of the project site. On the other hand, the project is not expected to have impact on the groundwater in the sense that only run off will be harvested during rainy season.

### **Mitigation measures**

The following mitigation measures have been suggested to safeguard against any negative impacts on water quantity and quality:

- ~ The supervising engineer in collaboration with the contractor should provide an appropriate design as per the guildlines.
- ~ Unwanted liquids and solids should not be introduced in the Matangi earth dam during rehabilitation process.
- ~ Water sample should be collected and taken to an approved laboratory for both bacteriological and chemical analysis to determine whether it is potable as per World Health Organization (WHO) guidelines for drinking water. If bacteriological contamination is detected, drinking water should be disinfected before by use of chlorine.
- ~ Monitoring water meter should be installed to monitor the amount of water abstracted.

- ~ Water conservation measures should be encouraged during the existence of the project.
- ~ The water catchment should be conserved by planting trees and protecting the existing trees and vegetation to minimize siltation of the dam.

### **6.3 Impacts on Biodiversity**

The impact on the biodiversity is expected to be low as the project site is devoid of significant animal and plant life. Arid vegetation within the proposed site will be trampled on during the rehabilitation, but this should recover well after completion. The following mitigation measures have been proposed for the potentially harmful chemicals:

#### **6.3.1 Fuels and lubricants**

There may be some oils and grease spillage on the ground from the machine that will be used in the rehabilitation works of the Matangi earth dam. Such oils can suffocate the grass around as well as have negative impact on the microbial life. However, the occurrence of these wastes is expected to be only minimal.

#### **Mitigation Measures**

Fuels are highly flammable and can cause destructive fire especially in this dry area; thus any form of ignition should be avoided in the project site during operation to prevent fire outbreaks. All fuels should be kept in a secluded section with “Danger’ or” Hatari’ tags in place. In case of spillage, oils and greases form a thin, suffocating layer on surface of water bodies and plants. They should be stored, properly handled and their wastes disposed safely during construction. Spills should be mitigated by scooping the affected earth and disposing it in a sanitary dumpsite. Repairing and maintenance of vehicles and other machinery involved in rehabilitation must be carried out at petrol station or garage to avoid fuels and lubricants spills at the project site.

#### **6.3.3 Solid Waste**

Solid waste generated will be minimal mainly vegetation debris from clearing of the dam and soils from de-silting. However, most of the soil will be used in embankment of the dam.

## **Mitigation Measures**

- ~ Excavated soils during de-silting should be used in embankment of the dam and the vegetation debris should be disposed off appropriately.

## **6.4 Socio-Economic Impacts**

### **6.4.1 Community Disruption**

All activities related to the project will be carried out within the selected point thus no external interference. The activities involved in the implementation of this project will have insignificant short-lived impacts to the workers and communities around.

### **6.4.2 Noise**

Loud noise can be a nuisance, while exposure to very loud noise over a long period of time can cause deafness. Noise produced during the implementation of the project will be highest at the de-silting stage.

## **Mitigation Measures**

It is recommended that all personnel participating in the dam rehabilitation process will use Personal Protective Equipment (PPEs) such as earmuffs for ear protection. The exhaust systems of the excavator and the compressor should be in good working conditions to reduce levels of noise. Further, no activity should be undertaken at night.

### **6.4.3 Provision of water- Positive impact**

The operation of this project will provide the most needed water to the residents of the area. Overall, the status of sanitation, hygiene and health of the community is expected to improve tremendously. The water will also reduce the distance covered in search of water. A committee on conflict management and resolution should be formed to deal with any emerging dispute on utilization of water.

### **6.4.4 Insecurity /vandalism**

The area has less security issues and therefore any equipment installed will less likely to be vandalist or storen. The earth dam site should also be fenced and a gate installed.

## **6.5 Impacts on Air Quality**

Air quality will only be affected by dust that will be emitted during de-silting stage and some exhaust fumes from the engines. This impact will be negative but short-term.

### **Mitigation Measures**

- ~ Earth stockpiles should be sprinkled with water to minimize blowing of dust.
- ~ The work crew should be provided with dust masks.
- ~ The excavator and compressor should be in good operating condition to avoid unnecessary exhaust fumes due to inefficient fuel combustion.

## **6.6 Health and Safety Impacts**

The machinery and equipment used during the rehabilitation process are potentially dangerous to the operators, workers and on lookers. The supervising engineer should oversee that the contractor adheres to the rules set by the authorities for the protection of his workmen and community around. Some of the mitigation measures include:

### **Mitigation Measures**

- ~ The Contractor should provide overalls, helmets, safety boots, earmuffs, nose masks and gloves for the workers, the supervising engineer and any other participants.
- ~ Ensure that the site is accessed by the work crew or authorized personnel only.
- ~ Ensure that there are no spills of petroleum, no smoking, no source of ignition and proper use of warning signs in explosive environment.
- ~ All project participants should have insurance and workmen's compensation.
- ~ The work crew should have a complete set of first aid kit for first aid in case of injury.
- ~ Emergency plans should be communicated and well understood.

## **CHAPTER SEVEN: SUMMARY OF ENVIRONMENT MANAGEMENT PLAN**

Effective implementation of mitigation measures highlighted in this document will ensure the appropriateness of the project. Commitments detailed in this project report are designed to avoid environmental damage in accordance with the Environmental Management and

Coordination Act, 1999, Environmental (Impact Assessment and Audit) Regulations Legal Notice 101 (2003) and the Water Act, 2016. The environment management enhancement procedures and techniques to conserve and improve the ecological and social environmental aspects should be incorporated in the EMP as summarized.

**Table 5: Environmental Management and Monitoring Plan**

<b>Environmental/ Social Impact</b>	<b>Proposed Mitigation and Aspects for Monitoring</b>	<b>Responsibility for intervention and monitoring</b>	<b>Impact Rating</b>	<b>Monitoring Indicators</b>	<b>Recommended frequency of monitoring</b>	<b>Budget for Mitigation Measures</b>
Impacts on Land and Soil - Mainly oil and grease spills, excavation	<p>~ Ensure management of excavation and de-silting activities.</p> <p>~ -Proper storage, handling and disposal of oil and oil wastes during rehabilitation works.</p> <p>~ Any maintenance of rehabilitation works machinery should be carried out in the contractor's yard off site or at a petrol station.</p>	Project Contractor	Low	Oil and grease spills on the ground	Throughout the dam rehabilitation period	Part of the dam rehabilitation cost
Impact on Air	~ Ensure proper working	Project	Low	General increase of	Throughout the	Kshs.300 000

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Quality — Mainly dust and fumes from machinery	<p>conditions of exhaust systems of the dam rehabilitating machinery.</p> <p>~ Water earth stockpiles,</p> <p>~ Provide work crew with dust masks.</p>	Contractor		dust and fumes in the vicinity of the project site.	dam rehabilitation period	
Impacts on Water Resources- Quality and Quantity	<p>~ Avoid entry of any undesirable material into the earth dam.</p> <p>~ Management of water usage to avoid unnecessary wastage of water.</p> <p>~ Fetching of the dam to exclude wildlife.</p> <p>~ Installation of master meter for measuring amount of water abstracted.</p>	Project Contractor	Low	<p>-Water quality analysis</p> <p>-Water level fluctuation in the earth dam.</p>	(0) Periodically	Kshs.150,000



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<p>Impacts on Public health and occupational safety</p>	<ul style="list-style-type: none"> <li>~ Provide proper protective gears to all workers.</li> <li>~ Ensure that there are no spills of petroleum, no smoking, no source of ignition and proper use of warning signs in explosive environment.</li> <li>~ All project participants should have insurance and workmen's compensation</li> <li>~ There should be a standby vehicle in case of any medical emergency and a contact for ambulance service provider.</li> <li>~ There should be presence of full equipped first aid kit at site.</li> <li>~ Ensure the availability of Emergency contacts for</li> </ul>	<p>Project Contractor</p>	<p>Low, but potentially high</p>	<p>Number of accidents/injuries recorded</p>	<p>(c) daily  Throughout the dam rehabilitation period</p>	<p>Kshs.80 000</p>
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	<p>police.</p> <p>~ Emergency plans should be communicated and well understood.</p> <p>~ Warning signs should be properly displayed and observed.</p>					
Impacts on Biodiversity	~ Replant any grass, shrubs that may be up-rooted during dam rehabilitation process.	Project Contractor	Low	Visual inspection of vegetation in the project site	(c) after Rehabilitation process (o) random	Ksh. 100,000
Community conflict	Formation of conflict management and resolution committee	Proponent	Low	-Cases of conflicts	-	-
Insecurity/Vandalism	~ Employ security personnel ~ Empower community	Proponent	Low	-Cases of vandalism	Monthly	To be

*Environmental Impact Assessment for Matangi Earth Dam project within Laikipia East Sub-County*

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	policing ~ Formation of the dam maintenance committee					determined
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## **CHAPTER EIGHT: CONCLUSIONS AND RECOMMENDATION**

The study has established that the proposed project will have massive benefits to the residents of Matangi and Yumiririe village and the surrounding areas that entail provision of water for domestic and agricultural use. This report has highlighted the major anticipated negative impacts and suggested adequate mitigation measures.

Therefore, it is in the opinion of the consultant that the few anticipated negative impacts that have already been mitigated, and on whole the proposed project does not pose any threat to the environment. The project should undergo annual environmental audit by competent environmental auditor to establish the level of implementation of the proposed Environmental Management Plan (EMP).

Thus, the experts recommend that the proponent to be issued with EIA license so that he can commence rehabilitation process required by law.

## REFERENCES

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- 7) Practical manual for small dams, pans and other water conservation structures in Kenya ( 2<sup>nd</sup> Edition).

## **APPENDICES**

- Photo log
- Copies of:
  - ~ EIA/A practicing license;
  - ~ Public participation questionnaires;
  - ~ Earth dam design
  - ~ List of participants

**❑ Photo Log**

	
Public participation meeting	Matangi earth dam site
	
Access road	Site neighbourhood