RIFT VALLEY WATER SERVICES BOARD

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR OLKALAU TOWN SEWERAGE PROJECT

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ACRONYMS

BOD	Biological Oxygen Demand
CBO	Community Based Organization
CEO	Chief Executive officer
EA	Environmental Audit
ECO	Environment Control Officer
EDL	Effluent discharge License
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
ELO	Environment Liaison Officer
EMCA	Environmental Management and Coordination Act
EMSF	Environmental Management and Social Framework
ESIA	Environmental and Social Impacts Assessment
ESMP	Environmental and Social Management Plan
GOK	Government of Kenya
GRC	Grievances Resettlement committee
KISIP	Kenya Informal Settlement Improvement Project
KMP	Kenya Municipal Program
KNBS	Kenya National Bureau of Statistics
MWI	Ministry of Water and Irrigation
NEMA	National Environment Management Authority
NUTIP	National Urban Transport Improvement Project
OP 4.01	World Bank Operational Policy on Environmental Assessment
OSHA	Occupational Health and Safety
PAPS	Project affected Persons
RC	Resettlement Committee
RE	Resident Engineer
RVWSB	Rift Valley Water Service Board
SUP	Socially Uplifting Project
ToR	Terms of Reference
UNDP	United National Development Programme
UNEP	United Nations Environment Programme
VCT	Voluntary Counselling and Testing
WB	World Bank
WHO	World Health Organization
WRMA	Water Resources Management Authority
WWTW	Waste Water Treatment Works

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EXECUTIVE SUMMARY

Rift Valley Water Services Board has commissioned Batiment Engineering and Associates to prepare an Environmental and Social Impact Assessment, an Environmental and social Management plan (ESMP) for the proposed Ol Kalou Town Sewerage Project. This study has been carried out within the framework of the guidelines and procedures spelt out in the Environmental Management and Co-ordination Act, 1999 and subsequent Environmental (Impact and Audit) Regulations, 2003, and as a result of consultations with the project proponent and other key stakeholders.

The project location is in Ol Kalou Town in Nyandarua County. Currently, there is no sewerage system in the town with sewerage functions being undertaken by the County Government of Nyandarua County through the use of exhauster services. Individuals' households use pit latrines, septic tanks and soak pits which are often exhausted and delivered at the open ponds within Ol Kalou waste management site. The liquid waste is then drained into aerobic plants found within the proposed site. The exhausted content finds its way to Ol Kalou River in its raw form causing alteration of river water and hence possible public health concerns to downstream water users.

The project is aimed at establishing a waterborne sewer network and a sewerage treatment plant in the town towards improving sanitation in the town and within its environs. The project will involve design and construction of new sewerage collection and treatment works in order to meet the current, future and ultimate demand for wastewater treatment in the target areas.

It is proposed that the construction of Ol' Kalou sewers system involves the construction and maintenance of approximately 14.296 Km of sewer lines of various sizes ranging from 160mm to 375mm uPVC pipes and socket flexible jointed construction of 1050mm to 1200mm manholes and other auxiliary works. The works also involve construction of 6 ponds with total capacity of 41,730 m^3 and Waste Water Stabilization Pond sewerage treatment system at Ol' Kalou Township at county government waste management site at an estimated project cost of Kes. 416,157,240.00.

The aim of this Environmental and Social Impact Assessment (ESIA) is to examine both the positive and negative effects that this proposed project undertakings is likely to have on both the bio-physical, socio-cultural, economic and environment. The ESIA process is an important planning tool for the project proponent as it will inform on significant project effects and clearly

define mitigation measures to avoid or curb adverse impacts. Early identification of possible impacts promotes environmental sustainability as anthropogenic factors are balanced with natural environmental needs. The Study sought to identify possible impacts that would arise as a result of the projects' activities namely; construction and operational phases. It also sought to recommend workable mitigation measures and formulate an Environmental and Social Management Plan to curb the negative impacts.

The study was carried out through extensive desktop study and field investigation. During the field investigations, reconnaissance survey was conducted to gather information on biophysical and socio-economic aspects of the area and its environs. The Environmental Impact Assessment study has been undertaken by the proponent in compliance with Kenya's legislation namely the Constitution of Kenya, Water Resources Management Rules, 2007Public Health Act, OSH Act 2007, and EMCA 1999 among others.

The following are the positive impacts that were identified during the ESIA study include but not limited to;

- Elimination of untreated sewage into Ol Kalou River
- Provision of wastewater management infrastructure for Ol-Kalou Town resulting to environmental conservation and management
- Provision of employment opportunities during both construction and operation phases of the project.
- A centralize town's wastewater treatment and making pollution monitoring easy and more effective.
- Improved health of the people- Reduced cases of respiratory and water borne diseases associated by poor sanitation due to poor domestic waste water management.
- Improved water quality Ol Kalou river, Malewa river and eventually, Lake Naivasha
- Enhanced aesthetic value in the area due to cleaning up of the sanitation mess that is currently experienced
- Sludge from the WWTW is a rich resource that can be utilized by the community around as fertilizers for crop production

There will be negative impacts emanating from the construction and subsequent operation activities of the sewage system. They include and not limited to the following:

- Contamination of drinking water sources by sewage can occur from raw sewage overflow, leaking or burst sewer lines, land application of sludge and partially treated wastes.
- The low lying flat nature of the site and proximity to the adjacent stream makes the site susceptible to flooding.
- Influx of heavy trucks and machinery in the area could cause nuisance, noise, dust and destruction of roads
- Loss of vegetation through stripping of top vegetation
- Soil erosion and destabilization of soil structure
- Atmospheric pollution by dust particles
- Increased noise and vibrations
- Influx of people in the area

Mitigation Measures to the anticipated negative impacts include;

- Erection of warning / informative signs at the construction sites during the construction phase, and traffic control along the Road.
- Soil compaction and watering of loose soils on all unpaved access areas at the construction sites to minimize air pollution and erosion by the agents of soil erosion i.e. water and wind.
- Ensure that the machineries are well maintained and ensure that the work is carried out during the recommended time and reduce noise
- Workers should be provided with full protective gear to beef up their health and safety standards and they should be sensitized on health, safety and environmental conservation aspects.
- The sites should be fenced off during construction to keep off animals and the general public
- Provision of sound waste management systems and procedures.
- Following the completion of the construction phase, measures will be undertaken to restore the affected biodiversity through landscaping

In conclusion, this study has been prepared to provide sufficient and relevant information on the proposed Ol Kalou Town sewerage Project, to enable NEMA establish whether activities of the project are likely to have significant adverse environmental impacts. In addition, the report responds to environmental assessments by the project financiers AFDB.

Considering the proposed location, construction, management and mitigation measures that have been proposed to be put in place and the project's contribution in the provision of a sewerage

component, employment creation and its socio-economic benefits to the people of Ol' Kalou Town, benefits of its implementation outweighs the identified negative impacts. That notwithstanding, all the identified negative Environmental and Social Impacts have been adequately addressed by the proposed mitigation measures through the recommended Environmental and social Management Plans. This environmental and social examination hence recommends that the proposed construction of OlKalou Sewerage System be implemented with full adherence of the developed Environmental Monitoring and Management Plan.

1. INTRODUCTION

1.1. Project Background

The detailed design of the proposed Ol-Kalou Town Sewerage Project in Nyandarua County is an undertaking of the Ministry of Water and Irrigation through the Rift Valley Water Services Board office. The project is for the construction of a sewerage system and treatment plant in Ol Kalou Town and is aimed at improving sanitation of the Ol Kalou Town and its environs. The project will establish a waterborne sewer network in the town and a sewerage treatment plant in the southern part of the Ol-Kalou Town in order to meet the current, future and ultimate demand for wastewater treatment in the target areas.

The proposed project works will entail the excavation and laying of sewer trunks, laterals and construction of waste water treatment lagoons.

This EIA Statement has evaluated the possible environmental, socio-economic, and occupational health and safety impacts of the proposed project during construction and operation phases. As a result, the report has documented and discussed various environmental and social issues/concerns/impacts and proposed most suitable methods of mitigating likely adverse impacts that may arise out of the proposed project.

The key findings that can be deduced from the environmental assessment are that the proposed project has potential positive and negative impacts. As a whole, the project would lead to multiple POSITIVE impacts with respect to human health and socio-economic improvements to the people of Ol-Kalou Town and it's environ. Improvements in health conditions are likely to occur as the result of improvements in surface, groundwater, and spring water quality due to reduced water pollution emanating from raw sewage. Consequently, it's anticipated that incidences of water borne diseases in the area will be reduced. Additional POSITIVE impacts would be observed at the socioeconomic levels. The proposed projects will create certain job opportunities, short term during construction and long term for its operation for both skilled and unskilled labour and as a catalyst of investments in the area. In addition, implementation of this project will reduce household burden of constructing and maintaining individual waste water treatment facilities. The county government will have an easy way of managing liquid waste within their jurisdiction.

During the project lifecycle, sources of negative environmental, health and safety impacts may result from site preparation, construction and operation activities. On-site and off-site impacts can be induced during the construction of the sewerage treatment plant, and later during its operation. On-site impacts result from construction activities carried out within the construction site. In this project the positive impacts far outweighs the anticipated negative impacts. However the recommended mitigation measures need to be adhered to.

With the rapid increase in the population of Ol-Kalou Town due to the increase in Rural-Urban migration, and the subdivision of ranches surrounding the town into small units, there is need for provision of adequate infrastructural facilities to take care of wastes generated within the town. Ol-Kalou Town is the county headquarters of Nyandarua County and is connected to the capital city by road. According to 2009 census, Ol-Kalou constituency had a population of 174, 877 and is projected to rise to 237,413 by 2015. Ol Kalou town has struggled to adapt to the influx of people and modernizing its sewerage system is of paramount importance.

Subsequent to the field work, analysis and meetings with the client, various county government officials and stakeholders in Nyandarua County, the Consultant established of the following concerning existing sanitation situation in Ol-Kalou Town as follows:

- There is no waterborne sewerage system in Ol-Kalou Town;
- Existing onsite sanitation facilities, mostly septic tanks frequently overflows into the nearby rivers causing serious faecal contamination especially during rainy season;
- embankment and lining of the existing oxidation ponds/aeration ponds at JM Kariuki Hospital were also damaged causing similar pollution concerns;
- The latrines present were observed to be in poor state posing health risk such as transmission of diseases such as cholera and typhoid.
- There are only two exhausters that serve the whole county. They are inadequate and incapable of serving the whole population.

1.2. Project justification or rationale

Currently, Ol Kalou town lacks a proper sewer system causing major challenges in liquid waste water management. Some of the challenges currently experienced are; There is no waterborne sewerage system in Ol-Kalou Town, most existing sanitation facilities like septic tanks were overflowing into the nearby rivers causing serious faecal contamination especially during the rainy seasons, the walls and lining of the existing oxidation ponds/ aeration ponds at J.M Kariuki hospital were also damaged causing similar pollution concerns and latrines are in poor state posing health risk such as transmission of diseases such as cholera and typhoid.

The proposed sewer treatment plant intends to; have full waterborne pond sewerage system with tanker discharge bays, Improvement of existing sanitation facilities owned by private and public institutions and individuals like septic tanks, conservancy tanks and oxidation ponds, Provision of exhausters to empty the septic tanks and conservancy tanks and Construction of ablution blocks in public places like schools, market and hospital. With the above interventions we expect; that the cost of liquid waste water management for institutions and individuals with Ol Kalou town will drop drastically, that it will create a system easy to control management of liquid waste water for the towns, improved hygiene and water situation thus lowering cases of water borne diseases. As such the project is justified.

1.3. Project Location

Figure 1: Projection location and main sewer route on Google map

Ol-kalou Township is located in Nyandarua County. It has an area of 371km^2 and consists of the urban, peri-urban and rural areas. It is located west of Aberdare Ranges and 40 kilometres East of Nakuru. Ol-Kalou town is connected by road to Gilgil, Nyahururu and forms a town council with a population of 47,795, of whom 19,583 are classified urban according to 2009 census estimates. Ol Kalou town council has five wards namely Gichungo, Kaimbaga, Ol Kalou, Ol Kalou Central and Rurii. The project area lies between latitudes 0º 16' S and 0º 14 S and Longitude 36º 22' E and 36º 31'E.

1.4. Rationale for an Environmental and Social Impact Assessment

Economic, social and environmental changes are inherent to new developments. Whilst development aims to bring about positive change if not well executed could result in conflicts both socially and in environmental aspects. The need to avoid adverse impacts and to ensure long-term benefits led to the concept of sustainable development. Environmental considerations are accepted as an essential feature of development.

For sustainable development to be achieved there is need to incorporate environment implications of any development activity. In order to predict environmental impacts arising from new development activities, and to provide an opportunity to militate against the perceived negative impacts an Environmental Impact Assessment (EIA) is carried out. Environmental impact assessment (EIA) procedure is developed with the aim of predicting the environmental implications of new developments and to plan ahead on the appropriate measures that would be applied to eliminate or reduce the foreseen potential aspects. Increased environmental awareness focuses attention on the environmental impacts on the environment both during the short term and the long term.

The Kenya Government policy on all new projects or activities requires an EIA to be carried out as specified in Second Schedule of EMCA (1999) at the planning stages of proposed undertaking to ensure that significant impacts on the environment are taken into account during the project cycle. The process of EIA contributes to the elimination, minimization or/and mitigation of adverse impacts by developing monitoring and mitigation measures to be adopted to address any negative impacts. Alternatives may comprise alternative sites, processes or implementation schedules. Findings from study contribute to an optimization of the project design, from both economic and environmental point of view.

The government of Kenya has created enabling environment through incentives for the investors to invest in Kenya. Many local and foreign investors have taken this government gesture seriously and started investing in Kenya in diverse sectors of the economy. The development of the sewer treatment plant is one of such economic options, which will create employment opportunities and offer income-generating opportunities to the surrounding communities.

This Environmental Impact Assessment (EIA) study report is carried out in conformity with the requirements of Environment Management and Co-ordination Act, 1999 and Environmental (Impact Assessment and Audit) Regulations 2003, and the waste disposal Regulations of 2006. According to section of the EIA/EA Regulations 2003 (legal No. 101), storage depots for LPG and Fuel fall under Item 10 of the Second Schedule (Management of hydrocarbons including-the storage of natural gas and combustible or explosive fuels) and are subject to the EIA process and the report submitted to the National Environment Management Authority (NEMA) for review and eventual licensing before the development commencement.

Through EIA studies impacts are identified, evaluated and mitigation measures sort to stop or reduce the impacts. Existing documents and designs of the projects formed vital source of information as a means of compliance with the legal framework. The proponent, project architect, structural and electrical engineers, the contractor and representatives of the neighbouring communities were key informants during the assessment process. Existing documents and designs of the project examined are attached at the end of this report.

1.4.1. Objectives of the ESIA study

The objective of the ESIA study was to carry out a systematic examination of the present environmental and social situation within the project area to determine whether the proposed project will have adverse environmental and social impacts to the surrounding area. The study included collection and analysis of environmental baseline data, identification of impacts (both positive and negative) analyses and evaluation of impacts, formulation of mitigation measures for significant negative impacts, analysis of project alternatives and development of environmental management and monitoring plans. Specifically, the study aimed at achieving the following specific objectives:

- To determine the compatibility of the proposed development with the neighbouring land uses.
- To identify and evaluate the significant environmental and social impacts of the proposed project
- To assess and analyse the environmental and social costs and benefits associated with the proposed project
- To evaluate and select the best project alternative from the various options available
- To incorporate environmental management plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project
- To incorporate stakeholder consultations into the environmental management process.
- To analyse the project alternatives available

1.5. Methodology

1.5.1. Screening Visit

Field survey helped to collect baseline information on the site and location surroundings. These observations derived information on physical characteristics, spatial, economic and social conditions of the project.

Group discussions were conducted with existing staff in the water and sanitation departments, neighbouring community and other administrative authorities. Discussions were also carried out with proponent and other experts in the environmental management field.

Questionnaires were administered to some key management staff to derive baseline information for the current and proposed development.

1.5.2. Project Report and Scoping

The scoping activity is undertaken to determine the range of activities to be addressed in the EIA project report. Scoping identifies serious significant and key concerns to evaluate, organize and present for decision making. It identifies the significant issues related to the project ensuring that indirect and secondary effects are not overlooked. Terms of Reference (TORs) for the ESIA study were also developed during scoping as following;

- Identify key issues of concern
- Ensure focus on key issues during the ESIA project report
- Determine the assessment method to be used
- Identify all affected persons
- Provide an opportunity for consultation and public participation
- Facilitate identification of alternatives
- Facilitate early agreement on contentious issues

1.5.3. Desk Study

Desk study and literature review was to establish available relevant information concerning environmental and social impacts of the proposed project. Desk search identified and verified relevant policies, legal and institutional framework. Internet was used to collect secondary information on sectorial issues as well as obtaining spatial images of the site.

1.5.4. ESIA Study

The ESIA study entails;

- To review various existing institutional framework on environmental planning and management for the proposed project.
- To collect baseline information on Ol Kalou sewerage treatment works project operations.

- To conduct interview and administer relevant questionnaire through various relevant stakeholders including the community.
- To identify and assess positive and negative impacts of the proposed project
- To identify and analyse alternative to the project.
- To develop mitigation measures and cost estimation for all negative impacts of the project.
- To develop an Environmental Management Plan and monitoring framework based on earlier findings.

1.5.5. Quantitative methods

a. Field sampling design

Field sampling will be done on both soil and water to collect actual status of the soil before project implementation. It will involve taking soil and water samples for analysis. Samples to be analysed and results submitted to NEMA. The result forms the baseline soil and water information before project implementation. The same will be done after project implementation to measure the impact level of the project and the changing parameter. This will help the management of the sewer system to rectify errors or improve the treatment system over time. The methods to be used for sampling will be simple random sampling method.

b. Water quality parameter

Water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

Environmental water quality, also called ambient water quality**,** relates to water bodies such as lakes, rivers, and oceans. Water quality standards for surface waters vary significantly due to different environmental conditions, ecosystems, and intended human uses. Toxic substances and high populations of certain microorganisms can present a health hazard for non-drinking purposes such as irrigation, swimming, fishing, rafting, boating, and industrial uses. These conditions may also affect wildlife, which use the water for drinking or as a habitat. Modern water quality laws generally specify protection of fisheries and recreational use and require, as a minimum, retention of current quality standards.

In Kenya, water quality is managed under the Environmental Management and Coordination (Water Quality) Regulations, 2006 (Cap. 387) gazetted on 29th September 2006 and the amended regulation of 2012 (L.N. No. 85 of 2012). These Regulations provide rules relative to the use and discharge of water for domestic, agricultural and industrial purposes make provision for the protection of water resources from pollution and define water quality standards.

The Regulations prohibit in general the pollution of water and unauthorized abstraction or use of water. The Regulations prescribe various standards for the quality of drinking water, water used in industrial processes and waste water used for irrigation. Specific mention is made of pollution of water used for fisheries and wildlife. The National Environment Management Authority shall monitor the quality of water used for domestic purposes whereas any local authority or person operating a sewage system shall monitor discharge of waste water into the environment.

The Schedules to these Regulations set out, among other things, quality standards for sources of domestic water, quality monitoring for sources of domestic water and other monitoring requirements, standards for effluent discharge into the environment and microbiological quality guidelines and standards for wastewater used in irrigation.

Table 1: water quality parameter for discharge

Parameter	**Max Allowable(Limits)**
1,1,1-trichloroethane (mg/I)	3
1,1,2-trichloethane (mg/I)	0.06
1,1-dichloroethylene	0.2
1,2-dichloroethane	0.04
1,3-dichloropropene (mg/1)	0.02
Alkyl Mercury compounds	Nd
Ammonia, ammonium compounds, NO_3 compounds and NO_2 compounds (Sum total of ammonia-N times 4 plus nitrate-N and Nitrite-N) *(mg/1)*	100
Arsenic (mg/I)	0.02
Arsenic and its compounds (mg/I)	0.1
Benzene (nig/1)	0.1
Biochemical Oxygen Demand (BOD 5days at 20 'C.) (mg/1)	30
Boron (mg/1)	1.0
Boron and its compounds - non marine (mg/1)	10

Boron and its compounds -marine (mg/1)	30
Cadmium (mg/I)	0.01
Cadmium and its compounds (mg/1)	0.1
Carbon tetrachloride	0.02
Chemical Oxygen Demand (COD (mg/I)	50
Chromium VI (mg/I)	0.05
Chloride (mg/I)	250
Chlorine free residue	0.10
Chromium total	2
cis -1,2- dichloro ethylene	0.4
Copper (m8/1)	1.0
Dichloromethane (mg/1)	0.2
Dissolved iron (mg/1)	10
Dissolved Manganese(mg/I)	10
E.coli (Counts / 100 ml)	Nil
Fluoride (mg/1)	1.5
Fluoride and its compounds (marine and non-marine) *(mg/1)*	8
Lead (mg/I)	0.01
Lead and its compounds (mg/I)	0.1
n-Hexane extracts (animal and vegetable fats) (mg/1)	30
n-Hexane extracts (mineral oil) (ng/1)	5
Oil and grease	Nil
Organo-Phosphorus compounds (parathion,methylparathion,methyldemeton and Ethyl parantrophenylphenylphosphorothroate, EPN only) (mg/I)	1.0
Polychlorinated biphenyls, PCBs **(mg/I)**	0.003
pH (Hydrogen ion activity-marine)	5.0-9.0
pH (Hydrogen ion activity-non marine)	6.5-8.5
Phenols (mg/I)	0.001
Selenium (mg/1)	0.01
Selenium and its compounds (mg/1)	0.1
Hexavalent Chromium VI compounds *(mg/I)*	0.5
Sulphide (mg/I)	0.1
Simazine (mg/1)	0.03
Total Suspended Solids, (mg/I)	30
Tetrachloroethylene (mg/1)	0.1
Thiobencarb (mg/1)	0.1
Temperature (in degrees celious) based on ambient temperature	± 3
Thirarn (mg/I)	0.06
Total coliforms (counts /100 ml)	30
Total Cyanogen (mg/1)	Nd
Total Nickel (mg/1)	0.3
Total Dissolved solids (mg/1)	1200
Colour in Hazen Units (H.U)	15
Detergents (mg/1)	Nil

Total mercury (mg/I)	0.005
Trichloroethylene (mg/1)	0.3
Zinc (mg/I)	0.5
Whole effluent toxicity	
Total Phosphorus (mg/I)	2 Guideline value
Total Nitrogen	2 Guideline value

c. Soil quality parameter

Although soil quality can be simply defined as a soil's "fitness for use", it is in reality a complex concept and significantly more challenging in its assessment than air or water quality. Soil quality can basically be divided into inherent and dynamic quality. The former is a component of land quality, whereas the latter is strongly influenced by the soil manager or user. Measurement of soil quality involves placing a value upon soil in relation to its fitness to perform a specific function or purpose. Functions can vary in relation to both use of soil and scale. Once a function has been established, it is possible to identify and characterize soil processes and attributes that describe the function, the indicators that are related to the attribute(s), and methodologies for measuring these. This allows the development of soil quality standards and control techniques, and subsequently the design of sustainable land management systems.

The Environmental study will involve soil chemical analysis with view of placing the baseline condition of the soil along the riparian zone where effluent will be discharged. The results will be filled and used to verify the impact of the sewers system on the soil quality. It will explain if there is introduction of pollutants to the soil along the riparian zone.

d. Mapping of Baseline Environment

This section explains in details the bio-physical environment parameters where the project will be situated. It also highlights the socio-economic situation of the site where the project will be situated. In our context mapping will be done to understand the biological environment of Ol Kalao i.e. flora and fauna of Ol Kalou, the physical features such as rivers, lakes, mountains, topology, the plant physiognomic features, soil, rocks, hydrological situation, administrative locations and boundaries and even the climatic parameters. Socio-economic parameter includes; land use programs, economic activities, infrastructure, communication, physical planning, religious

grouping, health, education and demographic data. These details are well captured in chapter 3 of this report.

e. Socioeconomic Survey

The socio-economic survey was paramount in knowing the status of the people in Ol Kalou Town. The survey sought to explore the socio-economic features of the project area and the opinion of individuals with an aim to identify potential social impacts. Data collected in this survey is household characteristics such as their income, expenditures and savings, land use and agriculture, housing and infrastructure, education, health, perception and expectations in regard to the project.

f. Public Consultations

Public consultations were used to obtain the general views on the public and stakeholders in Ol Kalou town on the proposed project. A desk study was conducted to identify the various key stakeholders and the general public to be impacted by the proposed sewerage project. Questionnaires were then administered to these groups to obtain their general feeling. Finally, the study team public / Technical Meetings at various levels and with different target groups

1.6. Study Limitations

Limitations are influences that the team of experts cannot control. They are the shortcomings, conditions or influences that cannot be controlled by the team that place **restrictions** on your methodology and conclusions. Some of the influences of the study are inadequate quality secondary data and lack of historical information recorded.

1.7. Structure of the Report

The structure of this EIA Project Report is as follows:

Executive Summary

Chapter 1: Introduction. This Chapter describes the background and rationale for an EIA, scope of the EIA, objectives of EIA, TOR, methodology of the EIA, consultant's compliance and reporting and documentation.

Chapter 2: Policy, Legal and Administrative Framework. This Chapter outlines Government

policy on the environment, the relevant legislation relating to the proposed Project and the administrative framework that deal with various aspects of environmental management.

Chapter 3: Institutional framework: This chapter outlines the various institutions that are related to the construction of the Ol Kalou Sewerage project. This wills assist in coordination of the project activity towards safeguarding the environment.

Chapter 4: Baseline Information. The chapter provides a description of the existing environment and social status to achieve an understanding of the environmental and social setting within Ol' Kalou Town.

Chapter 5: Project Description. This Chapter describes the Project location, current site condition; proposed scope of works which includes, site clearance and top soil stripping, earthworks, and construction of the perimeter wall. Estimated Project cost and EIA License fee is also described.

Chapter 6: Analysis of Project Alternatives. The Chapter describes the various alternatives that can be applicable to the proposed Project and the reasons for not using them.

Chapter 7: Public Consultation and Participation. The chapter describes the public consultations that took place with the residents through administration of questionnaires.

Chapter 8: Project Potential Impacts. The chapter identifies the potential impacts on the bio-physical and socio-economic environment during construction, operation and decommissioning phases and proposing and propose Mitigation Measures for the Anticipated Negative Impacts.

Chapter 9: Institutional capacity and training needs. This chapter outlines the various institutions and their capacity towards successful implementation of the project. Training needs will be outlined to ensure these institutions are able to discharge their mandate effectively.

Chapter 10: Environmental Social Management Plan. The chapter describes the measures to be taken and the monitoring requirements and responsibilities for mitigating the potential negative impacts. It also indicates the estimated costs for mitigating the impacts.

Chapter 11: Environment, Health and Safety Plan. The chapter provides a brief on

environment, health and safety during construction and operation will be undertaken.

Chapter 12: Conclusion and Recommendations. The chapter provides a brief non-technical summary of the report findings and recommendations.

2. POLICY, LEGAL AND REGULATORY FRAMEWORK

The management of domestic waste is dealt with under several laws, By-laws, regulations and Acts of parliament, as well as policy documents and it is not possible to bring all those statutes under one heading. This section is therefore aimed at assessing the existing policies and legislative framework, economic tools and enforcement mechanisms for the management of liquid waste at different stages. In so doing, the discussion will be based on the following legislations:

2.1. RELEVANT LAWS AND ACTS OF PARLIAMENT RELATING TO THE PROJECT

2.1.1. Environmental Management and Co-ordination Act, 1999

According to the Environmental Management and Co-ordination Act (EMCA, 1999, Second Schedule Part XII) and subsequent Environmental (Impact and Audit) Regulations, 2003, it is mandatory to get environmental clearance for certain development projects. Among these projects are;

Waste disposal projects including:

i. Sites for solid wastes disposal;
ii. Sites for hazardous waste disposal;
iii. Sewage works disposal
iv. Works involving major atmospheric emissions
v. Works emitting offensive odours

The proposed project therefore falls in the category of those that require clearance from NEMA before development.

a. Relevance to the proposed project

Section 3 *– Entitlement to Clean and Healthy Environment*

The Sewer Project shall be entitled to maintain a clean and healthy environment and has a duty to safeguard and enhance environmental management in accordance with sub-sections 1, 2, 3, 4, and 5.

Section 50 *– Biological Diversity*

The proposed Sewer project shall ensure that at the operation phases, conservation of biological diversity shall be observed as prescribed in (a) to (g) of this section

Section 78 – *Air quality*

The proponent shall enforce air quality standards and be maintained as per NEMA's Standard and Enforcement Review Committee requirements.

Section 87 *– Handling and Disposal of Wastes*

The proponent shall adhere to the disposal of wastes requirement in such a manner as not to cause pollution to the environment or ill health.

2.1.2. Environmental management and coordination (water quality) regulations, 2006

This regulation stipulates standards for discharge and license for any effluent into the environment

Section 10 *part 1 and 2 of the regulation stipulate water for industrial use and compliance with industrial standards:*

i. No person shall use water for trade or industrial undertaking unless such person complies with the standards established by the competent lead agency in regard to that particular activity.

ii. The Authority in consultation with the relevant lead agencies shall take measures to ensure compliance with the said standards by the owner or operator of the facility.

Section 11 *set standards for discharge into aquatic environment:*

No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit any person to dump or discharge such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards set out in the **Third Schedule** of these Regulations.

Section 12 part 1 and 2 sets standards for discharge into terrestrial environment:

1) Every local authority or person operating a sewage system or owner or operator of any trade or industrial undertaking issued with an effluent discharge license as stipulated under the Act shall comply with the standards set out in **Third Schedule** to these Regulations
2) Every local authority or person operating a sewerage system or owner or operator of any trade or industrial undertaking shall be guided by the monitoring guide for discharge into the environment as set out in the **Fourth Schedule** to these regulations or as the authority may prescribe.

Section13 of the regulation sets standard for discharge into a public sewer

Every owner or operator of a trade or industrial undertaking issued with a *license* by a local authority or sewerage service provider to discharge effluent into any existing sewerage systems shall comply with the standards set out in the **Fifth Schedule** to these Regulations.

Section 14 part 1 and 2 stipulates constant quantity and quality analysis and monitoring

1) Every person who generates and discharges effluent into the environment under a license issued under the Act shall carry out effluent discharge quality and quantity monitoring in

accordance with methods and procedures of sampling and analysis prescribed by the Authority, and shall submit quarterly records of such monitoring to the Authority or its designated representative.

2) Such discharge monitoring record shall be in the prescribed form as set out in **Sixth Schedule** to these Regulations.

Section if describe need to review the records

The Authority shall review monitoring records in order to verify compliance with these Regulations.

Section 16 part 1, 2 and 3 outlines the procedure for application of Effluent Discharge License EDL

1. An application for an effluent discharge license under the Act shall be in Form A of **Seventh Schedule** and accompanied by the prescribed fee as set out in Eleventh Schedule to these Regulations.
2. The decision of the Authority together with the reasons, Thereof shall be communicated to the applicant within thirty working days from the date of submission of the duly completed application
3. Where the Authority approves an application for the grant of aneffluent discharge license it shall issue an effluent discharge license within twenty-one days.

Section 17 pat 1 and 2 explain how the authority (NEMA) will issue an Effluent Discharge license

(1) An effluent discharge license issued under the Act shall be in Form B set out in the **Seventh Schedule** to these Regulations and shall be valid for such period of time as may be determined by the Authority.

(2) The Authority shall maintain a register for effluent discharge licenses as prescribed in Form C of the Seventh Schedule.

Section 18 restrict that the license is not transferable

An effluent discharge license issued under the Act shall not be transferable

2.1.3. Water Act, 2002

This Act prohibits the pollution of water. Part II, section 3 states:" Every water resource is hereby vested in the State subject to any rights of user granted by or under this Act or any other written law. Under Section 5, the right to the use of water from any water resource is vested on the minister for the time being in charge of water resources except to the extent that it is alienated by or under the Act or any other written law. Consequently, a water permit must be obtained before using any water resource. Water Services Regulatory Boards are established under section 46 as a body corporate. The Board shall issue licenses for the provision of water services, provide standards for such services and carry out other functions in relation with water supply outlined in section 47.

ACT NO. 8 OF 2002 - WATER ACT (1) part e gives WRMA the mandate to regulate and protect water resources quality from adverse impacts. Section 8 part 1 a, b gives WRMA power to issue licenses for water uses and abstraction from water bodies.

Relevance to the proposed project

Water is significant to the general operation of the proposed project. The construction would mean that more water would be needed for various activities. In case there will be need for abstraction from Ol Lalou River, the contractor must seek permit from WRMA. Management of this resource is therefore significant for the success of operations of the project. Pollution of water in the adjacent stream should also be avoided.

2.1.4. The Public Health Act (Cap 242)

The Public Health Act is the principle instrument for ensuring the health and safety of the people. Its core function is the prevention of disease, treatment and care of the sick (curative services) and control of nuisance. The Act therefore makes regulations and lays standards for a healthy living environment. Part XI Section 129 of the Act places the responsibility of protecting water supplies on the local authorities.

The Ministry of Health is in charge of administration of the Act with the Director of medical services as the Principal Officer. However, where a municipality is capable of discharging responsibilities under the Act, such a municipality is designated as a local health authority in such a situation the relevant powers under the Act are delegated to the municipality but the Director of Medical Services may take over if the Authority is in default.

Relevance to the proposed project

Section 115- During construction, a nuisance is prohibited especially for all conditions liable to be injurious or dangerous to health.

Section 118- Outlines nuisance liable to be dealt with i.e. accumulation or deposit of refuse, offal, manure or any other which is offensive or injurious or dangerous to health and an accumulation of stone, timber or other machine likely to harbour rats or rodents.

Section 126 rule 62 – Drainage & latrine rules- It is a statutory requirement that drainage, latrines, septic and conservancy tanks and any other pre-treatment methods of sewerage effluents seek written permission or/and approval from the local authority and be built in conformity to provisions of sub-rules (a) to (e) of this section.

Sections 136 – 143 Breeding places of mosquitoes-The civil and building contractors will ensure that during construction, breeding places of mosquitoes and nuisance yards are kept free from bottles, whole or broken. The project area shall not be overgrown by grass, the wells etc to be covered together with the less pits. The gutters may be perforated; larva destroyed to eradicate mosquitoes completely as mere presence of mosquito larvae is an offence.

Section 163 – Powers of entry and inspection -It should be noted that a medical officer, health inspector or a police officer above the role of an inspector shall enforce compliance and offences are punishable by law.

2.1.5. The Physical Planning Act, 1996

The Act provides for the preparation and implementation of physical development plans and other related purposes. Its provisions apply to all parts of the country except those areas as the Minister may specify. Thus the Act directs, regulates and harmonizes development and use of land over the country. In addition, the Act provides a vital link with the Environment Management and Co-ordination Act. For example, Section 36 of the Act states that" In connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant will be required to submit together with the application an environmental impact assessment report". This reinforces EIA requirements under EMCA (1999).

The Act creates the office of the Director of Physical Planning who is an appointee of the Public Service Commission. The Director is the chief advisor to the government on all matters relating to the physical planning and in addition performs such functions as are conferred upon him by or under the Act. However the Director at his discretion may delegate in writing any of his functions without diverting himself of such functions.

Under the act the director is assigned the responsibility of preparation of development plans. However, the control of development is vested in the respective local authorities. In the preparation of development plans, the act provides for the participation of the communities affected by such plans.

The Act establishes Physical Planning Liaison Committee at four levels namely; National, County level of Nyandarua, District and Municipality. The National Physical Planning Committee has the role of determining appeals lodged by aggrieved parties resolving matters referred to it and generally advising the Minister. The other committees deal with complaints against the Directors, arbitration on claims, development applications and appeals by aggrieved parties against the Director or local authorities. The property owners therefore are accorded the right of appeal against adverse decisions of planning authorities.

Relevance to the proposed project

This Act provides for order in terms of development execution which each region,

2.1.6. The County Government Act (2012)

Under the new constitution of Kenya, County Governments have taken over what used to be previously the functions of local authorities. They have been given power to control or prohibit all businesses, factories and other activities, including the proposed project which, by reason of smoke, fumes, gases, dust, noise or other cause may be or become a source of danger, discomfort or annoyance to the neighbourhood, and to prescribe conditions subject to which such business, factories, yards etc shall be carried. The new constitution grants county governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new constitution, the county governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and

wellbeing of the inhabitants of its area. This includes construction and maintenance of water supply, sewage and solid waste management systems.

Relevance to the Project

The proponent shall work in liaison with the County Government of Nyandarua and Ol Kalou Water and Sewerage Company to execute and operationalize the project according to the Development Plans.

2.1.7. Occupational Health and Safety Act 2007

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act.

Subsection 17 - Drainage of floors. Where any process is carried on which renders the floor liable to be wet to such an extent that the wet is capable of being removed by drainage, effective means shall be provided and maintained for draining off the wet.

Subsection 18 - Sanitary conveniences - Sufficient and suitable sanitary conveniences for persons employed in the factory/ work places shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences and where persons of both sexes are, such conveniences shall afford proper separate accommodation for persons of each sex.

Subsection 21 – Prime movers - Every flywheel directly connected to any prime mover and every moving part of any prime mover, shall be securely fenced, whether the flywheel or prime mover is to be situated in an engine –house or not

a. Head and tailrace of every water wheel and of every water turbine shall be securely fenced.
b. Every part of electric generators, motors and rotary converters and every flywheel directly connected thereto shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises as it would be if securely fenced.

Subsection 22 -Transmission Machinery- Every part of transmission machinery shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises, as it would be if securely fenced.

a. Efficient devices or appliances shall be provided and maintained in every room or place where work is carried on by which the power can promptly be cut-off from transmission machinery in that room or place.
b. Every machine intended to be driven by mechanical power shall be provided with an efficient starting and stopping appliance, the control of which shall be in such a position as to be readily and conveniently operated by the person operating the machine.

Subsection 25 - Construction and maintenance of fencing

All fencing or other safeguards provided in pursuance of the a foregoing provisions shall be of substantial construction, constantly maintained, and kept in position while the parts required to be fenced or safe guarded are in motion or in use except when any such parts are necessarily exposed for examination and for any lubrication or adjustments shown by such examination to be immediately necessary.

Subsection 13 – Cleanliness -Every factory/work place shall be kept in a clean state and free from effluent arising from any drain, sanitary convenience or nuisance.

Subsection 14 – Overcrowding -A factory/ work place shall not while work is carried on be so overcrowded as to cause risk of injury to the health of the persons employed therein. Standard cubic space allowed for every person in a workroom should not be less than three hundred and fifty cubic feet.

Section 51**:** Air pollution - Preventive measures shall be put in place during operation of the project to prevent fumes and exhaust gases from entering into the atmosphere.

Relevance to the Project

The Act is relevant both during construction and operation phases of the project due to the fact that the project will involve workers at all stages. Various health hazards are likely to emanate

from the proposed project's activities such as workplace accidents. Health issues will therefore be integrated into the project to ensure safety of workers.

2.2. LEGAL PROVISION FOR LAND ACQUISITION IN KENYA

The Kenyan law has an explicit provision for expropriation of land under any of the three categories as follows: -

2.2.1. Provisions under the Constitution:

In Kenya, expropriation is provided for in the Constitution under section 75 for private land and sections 117 and 118 for unregistered Trust Land. Section 75(1) provides that the Government can take possession of private land if this is necessary in the interest of town planning among other public interests, or if the development and utilization of the said land is to promote public benefit:-

- The development and utilization of the property will promote public benefit among other things.
- The necessity for expropriation is great enough to justify any hardship caused to any persons
- Law for prompt payment of full compensation makes the provision
- The constitution however only provides general guidelines, and detailed procedures for land acquisition are elaborated under the Land Acquisition Act in Chapter 295 for private land and Chapter 288 for unregistered Trust Lands

2.2.2. Procedures under Chapter 295

In approaching expropriation, a formal request to the Commissioner of Lands will be made by the benefiting authority, e.g. a municipal council in case of urban areas. Any other public body or Government may request for acquisition this way. The Commissioner will then forward the application to the Minister in charge of lands. If the minister is convinced that the land is required for public purpose, the Minister will write to the Commissioner to that effect, and directs the Commissioner to acquire the land (Section 6(1). The Commissioner will then give "Notice of Intention" to acquire the land (section 6(2) in the "Kenya Gazette" side by side with the "Notice of Inquiry". The public announcements will be made announced widely in standard mass communication avenues such as newspapers and on the radio.

The "Notice of Intention" must mention the public body or the public purpose for which the land is to be acquired. The "Notice of Inquiry" must mention places and fixed dates when persons interested in the subject land are to submit their claims to the Commissioner of Lands or his appointee (a "Valuation Officer" also known as "Collector of compensation") according to Section 9. Meanwhile, the Collector of Compensation will inspect the said land and value it for compensation. After the inquiry the Collector will issue an award depending on his own assessment and the representations of interested parties as submitted at the inquiry (Section 10 and 11).

The award is issued in the prescribed form indicating the amount of compensation awarded while the statement form gives the landowners option of acceptance or rejection of the award. If the landowner accepts the award, the collector will issue a cheque in settlement together with a formal "Notice of Taking Possession and Vesting" (section 19). The notice instructs the landowner to take his/her title for amendment or cancellation. It is copied to the Government Surveyor and the Land Registrar to make necessary changes to the affected deed. On the other hand, if the owner rejects the award, the collector deposits the money in court pending the former's appeal. Privately owned property, would have to be compensated for at the market value.

The general guiding principle is that whoever was using the land to be acquired would be provided alternative land of equal size and quality. An option for cash compensation in lieu of land may also be provided in case alternative land is not possible or not available. Replacement cost means replacement of assets with an amount sufficient to cover full cost of lost assets and related transaction costs. The cost is to be based on Market rate (commercial rate) according to Kenyan law for sale of land or property. Replacement cost for agricultural land implies the market value of land of equal productive potential or use located in the vicinity of the affected land, plus the costs of preparing the land to levels similar to those of the affected land; and any registration and transfer taxes.

2.2.3. Procedures for land Acquisition under Cap 288

Cap 288 allows for the expropriation of Trust Land on condition that;-The development and utilization of the property will promote public benefit among other things. The necessity for expropriation is great enough to justify any hardship caused to any persons Law for prompt

payment of full compensation makes the provision. Procedures under Cap 288 start with a proposal to a Full Council Meeting where proposed acquisition is deliberated and consent given vide a Council Minute. The "District Commissioner" in charge of the affected area will then proceed to ascertain interests, determine areas and assess compensation for the land after which he is to issue an award.

Section 12 of Cap 295 allows for in-kind compensation as follows:- Notwithstanding anything contained in the Government Lands Act, where the land is acquired for the Government the Commissioner may agree with the person whom he has determined to be the proprietor of the land that that person, instead of receiving an award, shall receive a grant of land, not exceeding in value the amount of compensation which the Commissioner considers would have been awarded, and upon the conclusion of the agreement that person shall, subject to section 18, be deemed conclusively to have been awarded and to have received all the compensation to which he is entitled in respect of his interest. An agreement under subsection (1) shall be recorded in the award.

It should be noted that, other than the in-kind compensation allowed for under section 12 of Cap 295, GoK policies seem to favour compensation based on issue of cash awards and only payable to people determined to be proprietors of the land or tenants to the land. There is no other policy provision for Resettlement and rehabilitation under the GoK system. Therefore the principles of OP 4.12 are taken into account in design of the Resettlement and rehabilitation assistance.

Section 8 (1) of Cap 288 allows for compensation as follows:- Where land is set apart under section 7 of this Act, full compensation shall be promptly paid by the Government to any resident of the area of land set apart who under African customary law for the time being in force and applicable to the land has any right to occupy any part thereof; or is otherwise than in common with all other residents of the land, in some other way prejudicially affected by the setting apart.

A notice of setting apart published under section 7 of this Act shall also be published by displaying a copy at the District Commissioner's office and at some other public or conspicuous place in the area concerned.

Under section 9.(1), a person who claims to be entitled to compensation under section 8 of Cap 288 shall apply therefore to the County Commissioner once satisfied after consultation shall award the applicant a sum of compensation in accordance with subsection (3) of this section; and if he is

not so satisfied the County Commissioner shall reject the application. The compensation to be awarded shall be assessed by the County Commissioner after consultation with the Divisional Board, and shall be assessed in respect of the loss of the right of occupation referred to in paragraph (a), or in respect of the applicant having been otherwise prejudicially affected as referred to in paragraph (b), of section 8 (1) of this Act. The County Commissioner shall give notice in writing to the applicant of the award or of the rejection of the application as the case may be.

2.2.4. Provisions of the Way-leaves Act (Cap 292):

Under Section 3 of this Act, the Government may 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. Under Section 4.(1), the Government shall, at least one month before carrying any sewer, drain or pipeline into, though, over or under any private land without the consent of the owner of the land, give notice of the intended work, either by notice in the Gazette or in such other manner as the Minister may in any case direct. The notice shall describe the nature of the intended work and shall name a place where the plan of the intended work is open for inspection at all reasonable hours. A copy of the notice shall either be served on every person resident in Kenya whose place of residence is known and who is known or believed to be the owner of any private land through, over or under which it is intended that any sever, dram or pipeline shall be carried, or shall 'be posted in a conspicuous position on that land.

Section 6.(1) of this Act requires the Government to make good all damage done, and shall pay compensation to the owner of any tree or crops destroyed or damaged, in the execution of any power conferred by this Act. In the event of disagreement as to the amount of the compensation to be paid or as to the person entitled to receive compensation, any person interested may apply to the assistant County Commissioner, who shall award to the person entitled to receive compensation such compensation as he thinks reasonable; and that award, subject to appeal to the County Commissioner, shall be final.

2.2.5. National Land Commission Act, 2012

The national land commission act was established and gazette on 2nd may 2012 in the *Kenya Gazette Supplement No. 36 (Acts No. 5). The act established the National land commission as envisaged by section 67(1) of the Kenyan constitution. Section 67(2). Section 5 (1) a – h outlines the functions of the national land commission which include:*

a) to manage public land on behalf of the national and county governments;
b) to recommend a national land policy to the national government;
c) to advise the national government on a comprehensive programme for the registration of title in land throughout Kenya;
d) to conduct research related to land and the use of natural resources, and make recommendations to appropriate authorities;
e) to initiate investigations, on its own initiative or on a complaint, into present or historical land injustices, and recommend appropriate redress;
f) to encourage the application of traditional dispute resolution mechanisms in land conflicts;
g) to assess tax on land and premiums on immovable property in any area designated by law; and
h) To monitor and have oversight responsibilities over land use planning throughout the country.

Majority of the land where the sewer treatment plant will be situated is owned by the County government of Nyandarua and the National Land commission has the sole mandate of managing public land as outline in part (a) above. As such, the proponent will work closely with the National land commission to get authorization to construct the sewer plant on public land for the best interest of Kenyans.

2.3. POLICIES AND OTHER PLANNING DOCUMENTS

2.3.1. The National Environmental Action Plan (NEAP) 1994

According to this plan, it's recognized that the development projects on the environment i.e. industrial, economic and social development programs that do not take care of environmental considerations in their operations are not sustainable. Under the NEAP process, EIA was introduced and among the key targets recognized were the industrialists, business community and local authorities.

2.3.2. The National Water Resources Management Policy (1999)

It enhances the systematic development of water resources for all the sectors in promotion of the country's socio-economic development. It also recognizes the by-products of these developments

as wastewater and therefore calls for development of appropriate sanitation systems to protect the people's health and water resources from institutional pollution.

It is therefore imperative that these activities be accompanied by appropriate waste management plans. The policy also recommends that all such developments should undergo comprehensive EIA that will provide measures to protect environment and people's health in the neighbourhood of the project including the downwind communities. As its predecessor, the EMCA (1999) calls for annual Environmental Audits (EA) to ensure continuous implementation of Environmental Management Plans (EMP) proposed in the EIA and any other recommendations and issues arising. The policy requires that those who pollute water bodies must pay the full cost of remediation of the contaminated water; in tandem with the "Polluter Pays Principle."

2.3.3. Sessional Paper No. 6 (1999)

Policy guidelines on environment and development – the key policy objectives of this paper includes:

- Ensuring that all development projects at the inception stage and programs, as well as policies consider environmental considerations.
- Ensuring that an EIA report is prepared for any undertaking or development project before implementation.
- Coming up with effluent treatment standards that will conform with acceptable health guidelines
- It's important to note that issues of waste water management and human settlements are given prominence and therefore, the policy recommends re-use and recycling of residues i.e. waste water, use of low waste generation technologies and increasing public awareness on benefits of a clean environment. It also recognizes the role of stakeholders in all these initiatives within their localities.
- The paper encourages better planning in rural and urban areas in provision of needs i.e. water, drainage system, waste disposal facilities et al.

Such documents included the Seasonal Paper No. 1 of 1999 and Vision 2030.

2.3.4. National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999)

The paper strive to restore order and prosperity in the water sector by ensuring sustainable water schemes while noting that the realization of this goal depends on the application of alternative management options and technologies that are participatory, rather than wholly recipient in nature. Chapter two paragraphs 2.6 addresses water quality issues and aim at protecting the available water resources from pollution. The cardinal sources of such pollution according to the paragraph are land use practices which have been carried out in total disregard of the need to conserve the water resources.

Another threat to the water resources according to the policy document are other human activities. In this regard, though proudly, the solid waste management could be considered as one of the land uses or human activities that could pose great danger to the available water resources if not well handled. In so viewing, the policy document provides for the consideration of an integrated approach in its actualization process.

2.3.5. Vision 2030

As a planning document, Vision 2030 is divided into three fundamental pillars: Economic, Social and Political pillars. The social pillar aims at realizing a just and cohesive society enjoying equitable social development in a clean and secure environment.

Under the Social Strategy, paragraph 5.4 of the strategy envisions Kenya becoming a nation that has a clean, secure and sustainable environment by 2030. So as to realize this strategy, the document explains that one of the specific strategies will be to improve pollution and waste management through the design and application of economic incentives, and the commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery.

2.3.6. African Development Bank policy on Environmental protection

The African Development Bank's environmental policy framework is strongly anchored in the concept of sustainable development. This concept defines sustainability as *"development that meets the needs of the present without compromising the needs of the future".*

The AfDBs Operational Safeguards (OS) include:

OS 1: Environmental and Social Assessment. this OS governs the process of determining a project's environmental and social category and the resulting Environmental and Social Assessment requirements. The requirements cover the scope of application, categorization, use of Strategic Environmental and Social Assessment (SESA) and Environmental and Social Impact Assessment (ESIA) where appropriate, Environmental and Social Management Plans, climate-change vulnerability, public consultation, community impacts, treatment of vulnerable groups, including indigenous peoples, and grievance procedures.

OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation. This OS consolidates Bank's policy on involuntary resettlement and incorporates a number of refinements designed to improve their operational effectiveness. In particular, the OS embraces comprehensive and forward-looking notions of livelihood and assets, to account for their social and cultural dimensions, as well as their economic ones. It also adopts a progressive understanding of community and common property that emphasizes the crucial need to maintain social cohesion, community structures and the social inter-linkages that common property provides.

***OS 3: Biodiversity and Ecosystem Services*.** This OS translates the policy commitments in the Bank's policy on integrated water resources management into operational requirements and also reflects the objectives of the Convention on Biological Diversity to preserve biological diversity and promote the sustainable use of natural resources. It reflects the importance of biodiversity in the African continent and the value to the population of key ecosystems. Its content has benefited from recent joint work among the MDBs to improve their approach to assessing how the potential impacts of projects on different types of habitats can be avoided, minimized or offset.

OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency: This OS covers the range of key pollution, waste and hazardous materials impacts for which there are agreed international conventions as well as comprehensive industry-specific standards that are followed by other MDBs and financial institutions that have adopted the Equator Principles. It also introduces a GHG emission threshold for projects to trigger a detailed analysis of feasible reduction or offset measures and reporting on emission levels. Borrowers or clients are required to consider measures to improve resource efficiency.

OS 5: Labour Conditions, Health and Safety. This OS aligns the Bank's requirements for its borrowers or clients with the range of ILO conventions concerning workers' conditions, rights -

and protection from abuse or exploitation. It covers working conditions, workers' organizations, and avoidance of child or forced labour and occupational health and safety.

3. INSTITUTIONAL FRAMEWORK

3.1. NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

The responsibility of NEMA is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.

i. Standards and Enforcement Review Committee (SERC)

EMCA provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC)

ii. Public Complaints Committee

EMCA has also established a Public Complaints Committee, which provides the administrative mechanism for addressing environmental harm. The Committee has the mandate to investigate complaints relating to environmental damage and degradation. The members of the Public Complaints Committee include representatives from the Law Society of Kenya, NGOs and the business community.

Relevance

RVWSB should address all issues arising from the project in accordance with the above committees.

3.2. COUNTY ENVIRONMENTAL COMMITTEES

The County Environmental Committees also contribute to decentralized environmental management and enable the participation of local communities. These environmental committees consist of the following:

- Representatives from all the ministries;
- Representatives from local authorities within the province/district;

- Two farmers / pastoral representatives;
- Two representatives from NGOs involved in environmental management in the province/district;
- A representative of each regional development authority in the province/district.

Relevance

The committees are empowered to discuss the environmental issues affecting their area of jurisdiction. RVWSB will therefore be required under the Act to liaise with the Nyandarua County Environmental Committee during the life of the project.

3.3. WATER RESOURCE MANAGEMENT AUTHORITY (WRMA)

WRMA is responsible for regulation of water resources issues such as water allocation, source protection and conservation, water quality management and pollution control and international waters. Its roles and responsibilities are as follows:

- Planning, management, protection and conservation of water resources;
- Planning, allocation, apportionment, assessment and monitoring of water resources;
- Issuance of water permits;
- Water rights and enforcement of permit conditions;
- Regulation of conservation and abstraction structures;
- Catchment and water quality management;
- Regulation and control of water use; and
- Coordination of the Integrated Water Resource Management (IWRM) Plan.

RVWSB in conjunction with the WRMA office in Naivasha town is responsible for the management of water quality and pollution control as a result to the effluent discharge into Ol Kalou River which is tributaries to Malewa River.

3.4. RIFT VALLEY WATER SERVICE BOARD

The Rift Valley Water Services Board (RVWSB) is one of the eight water services Boards in Kenya, formed under the provision of the Water Act 2002. The Board was established through Kenya Gazette Notice No. 1715 of 12th March, 2004 to provide water and sanitation services in the counties of Turkana, West Pokot, Parts of Elgeyo Marakwet, Baringo, Nakuru, Nyandarua and parts of Narok. RVWSB operates in a ten year licence issued by the regulator Water Services

Regulatory Board (W.A.S.R.E.B), on 25th September 2009 after the fulfilment of a set of regulations. RVWSB is the project proponent and will play a major role in ensuring the project follows all environmental management measures indicated in this report.

3.5. OL KALOU WATER AND SEWERAGE COMPANY

Ol Kalou Water and Sanitation Company (OLWASCO) is a Public Company formed under companies Act Cap 486 and it is regulated by the Rift Valley Water Service Board as well as the Water Service Regulatory Board in line with the provisions of Water Act 2002.Ol Kalou water and sewerage Company (OLWASCO) is mandated to supply safe and clean water to the people of Ol Kalou Town. After completion of the project OLWASCO will manage the project ensuring that the people of Ol Kalou town have clean sanitation services.

4. BASELINE INFORMATION

4.1. PHYSICAL ENVIRONMENT

4.1.1. Rainfall

The rainfall in the larger Nyandarua County intensity varies according to the location. Areas near Aberdare slopes receive sufficient rainfall with the plateau receiving scanty erratic rainfall. Kinangop plateau has two rain seasons with sufficient rainfall compared with the Ol Kalou and Ol Joro Orok plateau.

The Ol-Kalou is located on the leeward side of the Aberdare and this makes rainfall depressed from east to westwards, approaching the town. Areas close to the range receive high rainfall ranging between 1,000mm to 1,400mm and decreases on plateaus. The mean annual rainfall in the plateau is 750mm. The rainfall pattern is varied and falls in two peak seasons. The long rains in Ol-Kalou like in majority areas in Kenya occur in March-April and the short rain in October-November. December to -February are the driest months, and soil moisture and flow in natural streams is at lowest.

4.1.2. Temperature and humidity

Ol Kalou has moderate temperatures with an annual mean of 21.75°C and the lowest temperature is recorded in the month of July, with a mean average of 7.1°C. The district also experiences temperatures with adverse effects. The cold air that is generated during clear nights on the moorlands of Nyandarua Ranges flows down the Kinangop Plateau and Ol-Kalou Salient causing night frost nearly every month offers challenges to crop cultivation.

4.2. TOPOGRAPHY AND DRAINAGE

4.2.1. Geology

Geology of this area is described in the ‘’Geology of the Nakuru-Thomson’s Falls- G.J.H. MaCall (1967).Nyandarua County lies on the eastern edge of the East African Rift Valley. The geological history of the area can be followed from the Precambrian era (400 - 4,600 million years ago), which is represented by the metamorphic rocks of the "Mozambiquian Basement".

During Precambrian times, vast layers of sediments accumulated in a geosynclinal structure that covered most of the present Eastern Africa. Towards the end of the era, a period of regional folding and metamorphism occurred.

In subsequent Miocene, Pliocene and Pleistocene times, a great series of lava flows flooded out from the Rift Valley. The volcanic sheets, comprising plateau basalts and phonolites generally become thinner towards the east (i.e. with increasing distance from the Rift).

A short description of the different geologic units is given below in order of geological age (oldest rocks first).

4.2.2. Phonolites to the north of Ol Kalou

Lava with an unusual slaggy appearance, characterized by streaky textures and large gas cavities, occurs in inliers to the north of Ol Kalou. Thin sections suggest a trachytic composition but nepheline has been doubtfully identified in one slide and the rock would probably show a phonolite composition on analysis. Such lavas lacking visible felspathoids are common in the tops of flows of the Thomson's Fallsphonolite on SupukoLereko and it is probable that this lava represents the top of a phonolite flow and not a distinct lava formation. The Thomson's Falls and Rumuruti flows are not easily differentiated in the locality, fine textured lavas of both types being present and apparently intermingled, and the symbol Tvp has been used on the map to denote these unusual lavas, which have not been allocated to either division.

The Rumurutiphonolites of the Laikipia plateau have been described by Shackleton (1946, pp. 31-33). He also described Kapiti-type phonolites and the Losiolo (Kenya-type) phonolites closely associated with the predominant Losuguta-type. In both this phonolite group and the younger Dispei-Lake Hannington group Kapiti-, Kenya- and Losuguta-types may be found and, in the present area, these terms have lost any sense of stratigraphie notation they may once have had. The phonolites of the Rumuruti group are seen in deep sections in many localities. They form a succession of numerous lava flows, individual flows being much thicker than the flows of the Samburu group, averaging 50 to 100 feet. The flows are separated by weathered zones but there is little or no tuffaceous material associated with this group, as there is in the area to the west (Walsh, at the press).

The Rumurutiphonolites show a remarkable change in thickness from east to west. They thin out rapidly into the Rift Valley and the Samburu basalts emerge from beneath them, overlain only by isolated outliers of thin phonolite. Again a few miles east of Rumuruti rocks of the Basement System emerge from under these lavas which have their thinned out to nothing. In the zone of greatest thickness the lowest phonolites exposed—at the base of the Ngelesha Escarpment and the Marmanet Escarpment (immediately to the north of the Iguamiti gorge) and again on the road section down the Lolderodo Escarpment— are divided by joints into sheets dipping very steeply westwards towards the Rift Valley. These sheeted zones may represent the actual zones of eruption.

The phonolite wedged out against basalt in the middle of this trough and against its gentle outer slopes. To the north of Rumurutiphonolites conformably overlie sediments containing *Deinotherium*(Shackleton, 1946, p. 28) and a Miocene age has been assumed. There is no reason in the light of the present survey to doubt the validity of this dating.

4.2.3. Bahati and Kinangop tuffs

A continuous series of tuffs and "ignimbrites" extends from Bahati, immediately east of Menengai, to the plain of Ol Bolossat and the Kinangop plateau where older lava formations, the Simbara basalts and lavas of the Sattima series, emerge from beneath the tuffs, and the basalts of Oloronyi (called Laikipian by Shackleton) appear to do the same.

To the north of Ol Bolossat the tuffs are last seen as thin outliers of "ignimbrite" at Thomson's Falls airfield. They are absent in the great tracts of phonolite forming the Rumuruti plateau.

The main rock types in the succession are:—

- Cream to yellow pumice tuffs (with local development of water-lain graded tuffs).
- Thin welded tuffs of the type known as claystones.
- Massive flows of welded tuff with coarse fragmental, laminar and lenticular textures.
- Trachyte lavas, both well-crystallized types and streaky vitreous fragmental types, similar to those types on Menengai which grade into lenticulate fragmental flows indistinguishable from "ignimbrites".

At the base of the succession, under the tuffs of the North Kinangop, basalts and a very different type of tuffaceous sediments occur.

Pleistocene and Recent Superficial Deposits

These are thin unconsolidated or semi-consolidated deposits, which have accumulated since the volcanic eruptions ceased. There is little evidence by which they can be dated. Predominant deposits in the area include: *Red soils and Alluvium.*

4.3. SOILS

The soils in the County are of volcanic origin and vary in both fertility and distribution. The county is endowed with moderate to high fertile soils. Soils in the Kinangop and Ol' Kalou plateau are poorly drained clay loams. However, Ndaragwa, Northern part of Ol'joro Orok and Ol 'Kalou have well drained clay loams soils. These soils have different crop production potentials.

4.4. HYDROLOGY AND DRAINAGE

The County has four major rivers Pesi, Malewa, EwasoNyiro and Turasha. Malewa flows from the Aberdare ranges into Naivasha in the south. EwasoNyiro drains fromBahati escarpment through Ol JoroOrok to Laikipia. Turasha flows downwards to Naivasha while Pesi flows northwards to Laikipia. Most small rivers are drying up and this adversely affects the livelihood of the people in the district and beyond.

Lake Ol Bolossat is the only large natural water mass in the district. It is fed by streams and underground water seepage from the Aberdares and Dundori Hills. Human activities and clearing of the catchments areas for settlement has affected its natural refilling system and its existence is threatened.

The study area is marked by good prospects for sustainable groundwater development. The boreholes drilled in Ol Kalou area and its direct surroundings exclusively draw water from aquifers occurring within the Rumuruti Phonolites, and -further north- also from the younger Losioli Phonolites. Although the primary porosity of these lava flows is generally low, water occurs in fissures and other forms of secondary pore space, such as embedded weathered horizons (so-called Old Land Surfaces, or OLS) and bedding planes.

The volcanic sheet of the Laikipia Plateau supports a widespread, continuous regional aquifer system. The expected yield of a fully penetrating borehole roughly is a function of the effective secondary pore space, the depth of the phonolites, and the elevation of the regional water table. Recharge occurs over large areas: major faults may extend well beyond the surface catchment, thus intercepting adjacent aquifers or surface sources. The recharge mechanisms (and the rate of replenishment) of the local aquifers has not been fully established. The two major processes are probably direct recharge at surface (not necessarily local) and indirect recharge via faults and/or other aquifers.

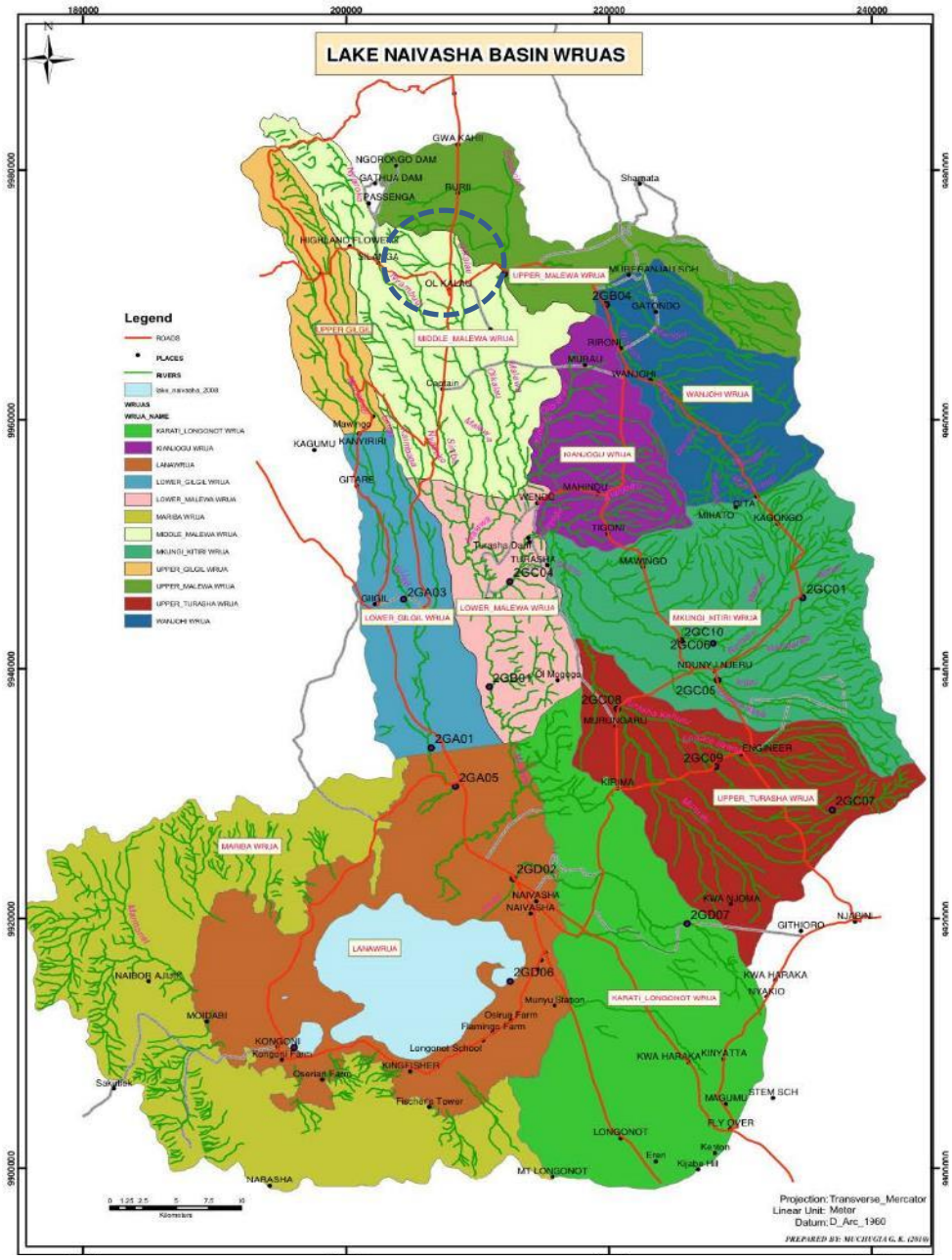


Figure 2: Ol Kalou Town in Naivasha Basin Drainage System

aquifer is low. Percolation will depend on the soil structure, vegetation cover and the state of erosion of the parent rock. Rocks weathering to clayey soils naturally inhibit infiltration and downward percolation. Aquifers may also be recharged laterally if the rock is permeable over a wide area.

In the present study area, the principal recharge zones are replenished along the open faults and fissure zones traversing the slopes of the Aberdare's Forest. Since must recharge is from Aberdare's forest, the lead expert doesn't expect the sewer to cause major alteration to the hydrological condition of the surrounding area

4.5. WATER RESOURCES AND KEY USES

4.5.1. Surface water resources

The County has four major rivers Pesi, Malewa, EwasoNyiro and Turasha. Malewa flows from the Aberdare ranges into Naivasha in the south. EwasoNyiro drains form Bahati escarpment through Ol JoroOrok to Laikipia. Turasha flows downwards to Naivasha while Pesi flows northwards to Laikipia. Most small rivers are drying up and this adversely affects the livelihood of the people in the district and beyond. Rivers are the key sources of surface in the county and Ol 'Kalou area where the project is located.

4.5.2. Underground Water Resources

The underground water situation is characterized with the phonolite lavas, weathered OLS, pyroclastic layers and bedding planes is often water bearing. However, in most cases such aquifers are only a few metres thick, and individual water bearing zones rarely produce yields in excess of 1-2 m^3/hr. Consequently, it may require several water strikes to obtain a reasonable yield. Higher yields (say >5 m^3/hr) can be achieved from boreholes located in "open" faults and fissure zones. The potential of structurally altered rocks is twofold:

Along faulted or fissured rocks weathering can penetrate much deeper, thus creating sub-vertical zones filled with relatively coarse, weathered material. These zones generally have a much higher transmissivity than their surroundings.

Recharge occurs over large areas: major faults may extend well beyond the surface catchment, thus intercepting adjacent aquifers or surface sources.

Although faults are often associated with water bearing zones, it should be noted that they may also act as impermeable barrier zones ("closed faults"). In this case the structure acts as a "groundwater dam" and significant storage may build up on its upstream side. Drilling inside such a closed fault system, however, would in most cases be futile.

Thirdly, there are faults or fissure zones that, despite having all the properties of a water bearing zone, are not productive due to a lack of recharge (dry, open fractures).

4.5.3. Existing boreholes

The boreholes within Ol Kalou area are drilled to a minimum depth of 60m and a maximum of 150m. The water strike level ranges from 50-140m below ground level and there are several aquifers. The borehole yield range from 1.1-27.27m^3/hr.

4.6. WATER DEMAND PROJECTIONS

Water demand projections have been made on the assumption that this will increase in tandem with the population growth.

4.6.1. Water consumption

The unit water consumption rates used in the design were based on the Ministry of Water Design Manual, 2005 with some modifications as in line with the socio economic survey findings.

a. Domestic water consumption

The per capita consumption rates for domestic water consumers adopted for the design was 90l/ca/day.

b. Institutional water consumption

The institutional water consumption rates adopted for the design are as presented in the Table 2 below;

Table 2: Institutional Consumption

Consumer	Unit	l/day
Day Primary schools	l/cap/day	25
Boarding Primary schools	l/cap/day	50
Day Secondary schools	l/cap/day	25
Boarding Secondary schools	l/cap/day	50
Dispensary (outpatient only)	l/visitor/day	20
District Hospital (outpatient)	l/visitor/day	20
District Hospital (in patient)	l/bed/day	200
Health staff	l/cap/day	25
Administrative Offices	l/cap/day	25

Population saturation in learning institutions is assumed to occur in 10 years that is 2020.

c. Commercial water consumption

The commercial water consumption rates adopted in the design are as presented in Table 3 below;

Table 3: Commercial unit water consumption rates

Commercial water users		
Enterprise	**Unit**	**l/day**
Hotels	l/bed/day	50
Guest Houses	l/bed/day	50
Shops	l/shop/day	100
Bars/restaurant	l/bar/day	500

d. Industrial water consumption

The industrial water consumption rates adopted in the design are as presented in Table 4 below;

Table 4: Industrial unit water consumption rates

Industrial water users		
Industry	**Unit**	**m^3/day**
Abattoir	m^3/day	50
Tannery	m^3/day	50
Meat processing	m^3/day	50
Food processing	m^3/day	50
Small Scale Industries	m^3/day	50

4.7. BIOLOGICAL ENVIRONMENT

4.7.1. Flora and Fauna

The county has 499.2 km^2 of forest area which is concentrated on the western side of the Aberdare Mountain range with four forest stations in South Kinangop, North Kinangop, Geta and Ndaragwa. It also includes Ol Bollossat wetland covering 33.3 km2. Out of the 499.2 km^2 of gazetted forests, plantation type of forest covers 84.3 km2, natural forests area 21.2 km^2, grass land 39.4 km^2, bush land 84.35 km^2 and bamboo 77.01 km^2.The total area under farm forestry is estimated to be 97.36 km^2 and is increasing. Most of the trees planted on farms provide a source of income when they are sold to saw millers.

4.8. SOCIAL CHARACTERISTICS

4.8.1. Population size and composition

The 2009 population census put the county's population at 596,268 (292,155 male; 304,113 female). The 2012 projected population based on a growth rate of 2.2% was 636,814 (312,022 male and 324,792 female). By 2015 the population is projected to grow to 680,342 (333,350 male; 346,994 female), and to 710,752 (348,251 male; 362,501 female) by 2017. The increase in the overall population calls for more investment in economic and social facilities, education, agriculture and health as well as creation of employment opportunities. The number of people employed was 30,918, which represented 9.3 %of the total labour force based on the 2009 census. The projected County labour force at 2012 is 334,054 (159,832 male; 174,222 female) representing about 37 % of the County's population. This number is expected to rise to 372,839 persons in 2017. The bulk of the labour force which is either unskilled or semi-skilled is mainly engaged in agricultural activities.

4.8.2. Household Headship

Most of the households (70%) are male-headed while female-headed and youth-headed households constituted 14% and 16% respectively. A typical household in the county has an average of five members. Disaggregated by gender, household mean size for male-headed households is five, and four for both female-headed and youth-headed households. The proportion of sex of household members comprised 52% male and 48% female. The mean age of household head for the overall sample is 50 years. The mean age is 53 years for male-headed households, 56 years for female-headed households and 31 years for youth-headed households.

4.8.3. Religion

Majority of Olkalou town dwellers and Nyandarua county residents are predominately Christians. However there are a few Muslims in town centres.

4.8.4. Education

Population currently in school

Pre-school Education

The county has 864 early childhood development (ECD) centres with a total enrolment of 26,964 pupils .This enrolment is 54.3% of the target population aged between 3-5 years. This means there are many children who have not been enrolled in ECD. There are 1,828 ECD teachers indicating a teacher pupil ratio of 1:17. The average years of attendance are two years.

Primary Education

The county has 508 primary schools with a total enrolment of 155,732 pupils. This enrolment is 95.3% of the county population aged 6-13 years. The number of primary school teachers is 3,573 with the teacher pupil ratio of 1:40. About three per cent of the children travel for less than one kilometre to school while 93% travel between1.1-4.9 Km. Four per cent of the children travel for more than five kilometres to school.

Secondary Education

The total number of secondary schools in the county is 185 schools with a total enrolment of 49,769. This enrolment is 50.3% of population aged 4-17 years. There are 1063 teachers in the county giving a teacher/student ratio of 1:28.The dropout rate in secondary school stands 5.8%. Students travelling less than one kilometre to a secondary school account for 12% of the total student population, while those travelling 1.1 to 4.9 km account for 54%. However those travelling for five kilometres and above are 34%.

The transition from primary school to secondary school is 21% meaning that 79% either join tertiary institutions or they drop out of school after completing primary school.

Tertiary Education

The county has 14 youth polytechnics and one Institute of Science and Technology (Nyandarua institute). There is one university branch of Maasai Mara University in both Kinangop and Kipipiri. This shortage in tertiary institutions has greatly affected the transition rates from secondary school to institutions of higher learning.

Education level for HH heads and spouses

About 89 % of all the household heads have attained some form of formal education, with the majority (79%) having gone to upper primary and secondary school levels. Those who have attained certificate/vocational level of education and above are only 7%.

4.8.5. Housing conditions

Majority of housing is out of corrugated iron sheet roofing and concrete. Other construction materials include wood and quarry stone.

4.8.6. Access to water

The town is served by a surface water system based on gravitational flow from Malewa River. The recently installed water supply system has the capacity to supply the Town with a water supply of 12,000 m^3/day against the current water demand of 16, 000 m^3/day. Boreholes are connected to the water supply system to augments the surface water during the 3 dry months (January to March) of the year.

The average distance to the nearest water point is 1.5km. 35,321 households have access to piped water while 21,154 have access to portable water. Most of the households depend on water from shallow wells, roof catchments and rivers. Ol 'Kalou Township is supplied with water from Ol 'Kalou water and Sewerage Company.

4.8.7. Water treatment and sanitation

Presently, Ol-Kalou Town has no waterborne sewerage system. The most common type of household sanitation in use is mainly pit latrines and only a few middleclass residential areas have installed flash toilets connected to septic tanks. The district hospital is the only institution with some form of wastewater treatment system. However the system is in a poor operation state with blocked sewer lines and damaged treatment ponds thus discharging raw sewage into the adjacent streams. Some disused treatment ponds were traced on the southern part of Town. There were littered with solid wastes and evidence of the dried sludge being collected for use as manual in nearby farms

On waste disposal, 92 % of the population has access to latrines with 81 % utilizing pit latrines, 8 % VIP latrines and 3 % flush toilets. There are no sewerage systems in the county. Garbage

collection by the town and County Councils within the county cover a small %age as only two % of the waste is collected by the local authorities. There are no private firms engaging in waste disposal. This has a negative effect on the environment and hence proper mechanisms for waste disposal need to be put in place to ensure the county remains clean.

4.8.8. Medical facilities and health condition

There are two level four public health facilities in the county, one mission hospital, three nursing homes, seven level three health facilities, 32 level two facilities and 50 private clinics. The doctor population ratio is 1:155,188 and nurse population ratio is 1:2,150. The average distance to the nearest heath centre is 3.2 km. In the county, 21 % of the households travel up to one kilometre to access health service, 78 % travel between 1.1 km and 4.9 km while those who travel above five kilometre account for one % of the population.

4.9. ECONOMIC CHARACTERISTICS

4.9.1. Employment status of persons living in the project area

The total eligible labour force for the county is 334,054 with 159,832 males and 174,222 females. The majority are in the agriculture sector as they are either unskilled or semi-skilled. The employment level in the county is at 16.9 % and unemployment level is 83.1%.

4.9.2. Income sources

Agriculture is the major source of livelihood and source of income that drives the county's economy. The county has high potential for agricultural production. Agriculture is the main source of household food and provides raw materials to agro-based industries. The county has two rain seasons with long rains receiving a maximum of 1700mm and 700mm during the short rains. The highest temperature is recorded in the month of December, with a mean average of 21^0C while the lowest is recorded in the month of July, with an average of 7^0C.

The current area under food crops is 63,370 ha. The main food crops include potato, cabbage, peas and carrots. Cash crops are wheat, fruits and cut flowers. There are two National Cereals and Produce Board (NCPB) stores located in Ol'kalou and Leleshwa (Kipipiri). The two NCPB stores

have capacities of 10,800 MT each. The main livestock reared include indigenous and exotic species of cattle and goats, sheep, rabbits and poultry. Bee keeping and fish farming are other activities carried out in the county. There were 989 fishponds constructed under the economic stimulus programme where the main fish species reared are tilapia, trout and common carp. To spur growth and promote value chain development, the Agricultural Sector Development Support Programme (ASDSP) with stakeholders in the county identified dairy, Irish potatoes and fish as the priority value chains.

The county received about KES 17 billion as income generated from crops; with Irish potato contributing about KES 12.2 billion (Table 1.2). Income from livestock was KES 7 billion with dairy giving KES 6.3 billion, beef KES 423 million, poultry KES 173 million and fish KES 1.2 million (Table 6).

Table 5: Crop production in the County, *Source: Economic Review of Agriculture, 2012*

Crop	Production (MT)	Value (KES million)
Irish potato	983,050	12,205.9
Cabbage	233,550	2,981.1
Maize, dry	36,709	954.8
Wheat	6,318	189.9
Beans	3,845	200.5
Sorghum	10.4	0.27
Kale	22,519	147.8
Tomato	794	23.7
Carrot	19,726	357.2
Sweet potato	918	2.20
Total	**1,307,439.4**	**17,063.37**

Table 6 shows the quantities and estimated value of outputs from livestock in the county.

Table 6: Quantity and value of livestock and livestock products, Source: Nyandarua County Development Profile, 2013

Beef (kg)	1,509,480	422.6
Mutton (kg	603,338	193

Chevron (kg)	69,586	25
Pig meat (kg)	22,260	5.5
Hides and skins (kg)	73,753	1.4
Table fish (kg)	6,113	1.2
Milk (million litres)	223.5	6,260
Poultry (kg)	-	173
Total	-	7,081.7

Some of the major challenges to agricultural production in the county include:

- Poor road network: The poor state of road network greatly affects transportation of agricultural and livestock products from the farms. It also affects the provision of other services such as: agricultural and livestock extension services, health, education and security.
- Declining production and productivity: The proportion of arable land available has been under-utilized due to the ever increasing costs of production. Prices of inputs have been high and their distribution not well coordinated. Shortage of inputs has led to low productivity in Irish potato, cabbages, peas, carrots and kales. Manufactured feeds for cattle and poultry are expensive for farmers across the county. In addition, the collapse of many agricultural cooperative societies imply that most of the farmers no longer access cheap credit facilities and bulk marketing which fetches good prices.
- Poor marketing systems: Due to the poor marketing infrastructure, farmers have resorted to selling their farm produce to the middlemen at very low prices making farming an unprofitable venture. Lack of market information and poor technological know-how make farmers unaware of better market for their produce and the various seasons when they could fetch good prices. Following liberalization of the dairy sector, many cooperative societies collapsed due to their inability to compete in the market and mismanagement
- Lack of value addition: Marketing of local products is also affected by inability of local producers to undertake value–addition ventures. This has been occasioned by unavailability of power in many rural areas and lack of knowledge and skills.

- Inadequate supply of electricity and other sources of energy: the lack of electricity connection in most rural areas has hampered the local producers to undertake value addition ventures.

4.10. LAND TENURE AND OWNERSHIP

According to the KNHBS (2005/06), 78% of land parcels in the county have title deeds. However in some areas such as Mirangi-ini, most farmers in the former settlement schemes have no title deeds while others have allotment letters. There are few incidences of landlessness in the county. The average farm size is 3.9 acres; disaggregated by gender, male-headed households owned 4.2 acres, female-headed owned 2.9 acres and youth-headed owned 3.7 acres. On average most households own and/or accessed two parcels of land, however male-headed households accessed one parcel compared to two accessed by female- and youth-headed households. The average distance from homestead to various parcels of land is 9 to 12 km away from the parcel where the homestead is located. For the parcels where the homestead is located, 92% of the parcels are owned by the household head and/or the spouse. A similar trend is observed for the other parcels, except the proportion of land rented that are higher. However, the internally displaced persons who flocked the area after the post-election violence in 2008 increased the number of people without land.

4.10.1. Land use potential and agricultural activities

Out of the total area of the County, 201,100 ha are arable. The estimated area under food crops is 63,370 ha that includes potato (16,120 ha), cabbage (10, 200 ha), peas (9,650 ha), carrots (2,840 ha) and other food crops (24,560 ha). The main cash crops in the area are wheat, fruits and cut flowers and cover about 58,344 ha with wheat occupying 58,000 ha, fruits 204 ha and cut flowers140 ha. The mean holding size per household is 3.5 ha, average farm size for small scale is 1.2 ha and large scale is 24 ha.

4.11. ENERGY SOURCES

Main source of cooking energy is firewood while electricity covers 10.5 % of the county and is mainly found in urban centres of Mairo-inya, Ol'kalou, Njambini and Engineer and several trading centres located in different parts of the county. The total number of households using electricity for cooking is 0.2 %, while77.8 % of household use firewood as the main source of cooking fuel. The proportion of households using charcoal is 19.3 %, paraffin is 1.4%, and biomass residue is 0.3%. Households using firewood for lighting are 0.3%; paraffin 82.7 %, electricity 10.5 %, and solar 6.0 %.

4.12. ROADS ACCESS

The county of Nyandarua has a relatively well developed road network linking it to other counties. There are also those roads linking trading centres within the county. The following roads are the main roads that affected movement of good and people within the county: -

- Nairobi – Nakuru road (Class A 104)
- Nyahururu – Nyeri road (class B5)
- Nyahururu – Gilgil road (class C77)
- Dundori – Ol'kalou – Njabini road (class C69)
- Lanet – GwaKiongo – Ol'JoroOrok road (class C83)
- GwaKungu – DB Laikipia road (class C76)
- Githioro – Kirima road (class67)
- Njabini – Gatura road (class 67) and
- Njabini –Magumu road (class C68)

Other equally important roads in the county include; - GwaKiongo – Tumaini – Gilgil road, Nyahururu – Bioman – Charagita, Boiman – Laikipia University, K.A.R.I – Ngano – Charagita, Ndaragwa – Kanyagia, MairoInya – Shauri – Ndogino - Karampton, Ndaragwa – Uruku – Pesi, Captain – Ndemi – Wanjohi – Geta, Machinery – Gilgil and Haraka – Mukeu - Githioro roads.

5. PROJECT DESCRIPTION

5.1. INTRODUCTION

The project entails the construction of a public sewer system for Olkalou Township in Nyandarua County. Due to increasing population, several challenges of sanitation have faced to town and thus the need to incorporate and efficient waste water management system. The project will be implemented in Ol'kalou Township.

5.2. PROJECT LOCATION

Ol-Kalou Town is located in Ol-Kalou Division, in Nyandarua County. It has an area of 371km^2 and consists of the urban, peri-urban and rural areas.

Ol-Kalou Town is located west of Aberdare Ranges and 40 kilometres east of Nakuru. Ol-Kalou is connected by road to Giligil, Nyahururu and forms a town with a population of 47,795, of whom 19,583 are classified urban according to 2009 estimates. Ol Kalou town council has five wards namely Gichungo, Kaimbaga, Ol Kalou, Ol Kalou Central and Rurii. The project area lies between latitudes 0^o 16' S and 0^o 14 S and Longitude 36^o 22' E and 36^o 31'E

Figure 3: satellite Image of Ol Kalou Town

5.2.1. Population, Water Demand and Effluent Discharge Levels

The 2009 National Census populations by the Kenya National Bureau of Statistics for the Project Area as indicated in Table 8 below have been used for population projections and water demand assessment.

Table 7: Projected populations within the project area

Sub-location	Population						
	2009	2012	2015	2020	2025	2030	2035
Urban Area	19,583	21,274	23,112	25,811	30,463	34,973	40,151

Annual growth rate (%)		2.8%	2.8%	2.8%	2.8%	2.8%	2.8%

The summary of the demand for the water supply in the sewered areas of Ol-Kalou Town is as shown in Table 8 below:

Table 8: Summary of the water demand per user category in the sewered areas

Demand category	**Total demand (m^3/day)**					
	2012	**2015**	**2020**	**2025**	**2030**	**2035**
Residential	1,340	1,456	1,626	1,919	2,203	2,530
Institutional & commercial	198	191	260	309	367	436
Industrial	210	228	262	301	345	396
Total demand	**1,748**	**1,876**	**2,148**	**2,529**	**2,915**	**3,362**

The wastewater generated from above has been calculated as 80% of the above water demands and the projected volumes over the design horizon are presented in the Table 9 below.

Table 9: Wastewater generated by different water user categories

User category	**Wastewater generation (m^3/day)**					
	2012	2015	2020	2025	2030	2035
Total discharge	1,398	1,500	1,718	2,023	2,332	2,689

Note

The sewer system was designed to take care of the town and above projected effluent discharge amounts per day.

5.3. SEWER DESIGN CRITERIA

5.3.1. Design concept

The Ol-Kalou Town sewerage system has been designed to cover the core or central part of Ol-Kalou Town covering a population of 19,583 persons. Sewerage system designs capacity (PDWF) is 1,000 m^3/day. Treatment works design capacity however includes 20% additional flow due to infiltration during wet weather. This has not been considered for the first 10 years.

5.3.2. Project Description

Construction of Ol' Kalou sewers involves the construction and maintenance (during the defects liability period) of approximately **14.296 Km of sewer lines** of various sizes ranging from 160mm to 375mm uPVC pipes and socket flexible jointed, diameter 1050mm to 1200mm manholes and other auxiliary works and 6 ponds Waste Water Stabilization Pond with total volume of all the six ponds being **41,730 m^3** (Annex 1).

5.3.3. Project Components

The project is broadly in three components:

a) The sewer trunk

A sanitary sewer or "foul sewer" is an underground carriage system specifically for transporting sewage from houses and commercial buildings through pipes to treatment or disposal. Sanitary sewers are part of an overall system called sewerage or sewage system.

The sewer trunk for Olkalou sewer system will compose of 12 different sewer trunks leading to the final destination where stabilization ponds are located. The total length of the sewer trunks will be 14.296 km. The shortest trunk measures189m while the longest trunk measures 3633m. The pipes to be used are those of uPVC and concrete quality and will have variable diameters ranging from 160mm to 375mm. the maximum velocity to be attained will range from 0.91 to 1.46. The design of the trunk is designed to achieve a slope average ranging from 24.38 to 123.76 the detailed description of the trunks is as shown in table 10 below:

Table 10: Description of project designs of Trunks

TRUNK	TOTAL LENGTH (M)	RANGE OF PIPE DIAMETER (MM)	AVERAGE SLOPE	MAXIMUM VELOCITY M/S
TRUNK 1	1571	160-200	45.71	1.09
TRUNK 2	1299	160	56.72	0.95
TRUNK 3	727	160	-	0.44
TRUNK 4	961	160-200	82.84	1.06
TRUNK 5	3633	250-315	80.73	1.38
TRUNK 6	788	160	29.19	1.04
TRUNK 7	1392	160	25.76	1.29
TRUNK 8	1681	200-225	53.67	1.33
TRUNK 9	775	160	38.31	0.94
TRUNK 10	1030	160	53.51	0.91
TRUNK 11	189	160	24.38	1.46
TRUNK 12	250	225-375	123.76	1.06

b) Manholes and manhole covers

Manholes shall be constructed on sewer lines in the positions indicated on the plan drawings or wherever ordered by the Engineer.

Manholes on pipe sewers shall be constructed with an in-situ base as detailed on the drawings which shall be raised to form the benching and channels shall be carefully formed to shape according to the number, diameter and positions of the incoming and outgoing pipes. The channels in the manhole bases shall have circular inverts. The benching shall be sloped towards the channels at a gradient of 1 in 5. The whole system is designed to have a maximum of 265 manholes with their covers. The manhole diameter will vary from 1050mm to 1200mm. each trunk will have different number of manholes. Table 11below shows the number of manhole per trunk and the range of manhole dimension:

Table 11: trunks and range of manhole dimension

TRUNK	NO. OF MANHOLE PER TRUNK	RANGE OF MANHOLE DIAMETER (MM)
TRUNK 1	27	1050-1200
TRUNK 2	23	1050-1200
TRUNK 3	13	1050-1200
TRUNK 4	17	1050-1200
TRUNK 5	62	1050-1200
TRUNK 6	29	1050-1200
TRUNK 7	24	1050-1200
TRUNK 8	29	1050-1200
TRUNK 9	14	1050-1200
TRUNK 10	18	1050-1200
TRUNK 11	4	1050-1200
TRUNK 12	5	1050-1200

C) **Waste water stabilization ponds**

Waste stabilization ponds (WSP) are well-established methods for sewage treatment in tropical climates. This is a biological natural process that provides ecologically-sustainable wastewater treatment system and has the capability of meeting the demand for a high percentage removal of pathogenic organisms, compared to conventional technologies.

In the WSPs, raw sewage is treated entirely by natural processes involving both algae and bacteria. This process is very effective in the removal of faecal coliform bacteria and does not require mechanical mixing, and only sunlight energy is required in the oxygenation process. Minimum supervision for daily operation which involves simple cleaning of outlets and inlet works is required.

The main advantages of WSPs therefore include: simplicity, low cost, low maintenance, low energy consumption, robustness, and sustainability.

Construction of the wastewater stabilisation ponds is simple and relatively cheaper than the conventional methods of wastewater treatment. In addition they require low operational and maintenance cost.

The sewer system will employ screening of waste before entry into the ponds. Screening process will have a grit chamber, sullage channel with parshall flume and a distribution chamber.

i. Anaerobic ponds

Anaerobic waste stabilization ponds are open basins in which wastewater is treated in the absence of oxygen. Solids settle to the bottom of the pond, where they are digested.

Once in the pond, the faecal matter settles into two layers: solid, or sludge, layer and the liquid layer. The manure then will undergo the process of anaerobic respiration, whereby the volatile organic compounds will be converted into carbon dioxide and methane. Anaerobic ponds are usually used to pre-treat high strength industrial wastewaters, and municipal wastewaters. Ol' Kalou sewerage treatment plant will have two anaerobic ponds each measuring 30m by 30m and a depth of 2.5m

ii. Facultative ponds

Facultative ponds are a type of stabilization pond used for biological treatment of industrial and domestic wastewater. Sewage or organic waste from food or fibre processing will be catabolized in ponds where adequate space is available to provide an average waste retention time exceeding a month. A series of ponds prevents mixing of untreated waste with treated wastewater and allows better control of waste residence time for uniform treatment efficiency. The facultative pond in the pond sequence will functions like the primary clarifier of a conventional sewage treatment system. Heavy solids will settle to the bottom of the pond, and lighter solids will float. The surface area of the pond is large enough to provide an atmospheric oxygen transfer rate adequate to prevent anaerobic conditions on the lagoon surface. Intermediate depths of the pond support facultative micro-organisms capable of oxidizing both the dissolved and suspended organics from the original wastewater and the products of anaerobic catabolism on the bottom of the pond. The Ol' Kalou sewer system will have one major facultative pond measuring 180m by 60m and a depth of 1.5m.

iii. Maturation ponds

Maturation ponds (low-cost polishing ponds), will follow the facultative pond, are primarily designed for tertiary treatment, i.e., the removal of pathogens, nutrients and possibly algae. They are very shallow i.e. 1.2m, to allow light penetration to the bottom and aerobic conditions throughout the whole depth. The loading on the maturation ponds is calculated on the assumption that 80% of the BOD has been removed in the preceding treatment. Maturation ponds are designed for faecal coliform removal. The Ol 'Kalou sewer treatment plant will have three maturation ponds each with a depth of 1.2m with varying dimensions.

Table 12 below lists the type of ponds, their dimensions and capacities:

Table 12: type of pond, their dimension and capacities

Type of pond	Measurements			Volume	Number
	Length	**Width**	**Depth**		
Anaerobic pond	30	30	2.5	4,500	2
Facultative pond	180	60	1.5	16,200	1
Maturation pond					
a) **Maturation 1**	125	65	1.2	9750	1
b) **Maturation 2**	110	60	1.2	7920	1
c) **Maturation 3**	70	40	1.2	3360	1

Other support Amenities

Apart from the stabilization pond, sewer trunks and manholes there are other support amenities that will support the function of the sewer treatment plant. They are:

- Tankers Discharge bay – where exhausters will empty transported effluent
- Access roads and parking
- Utility building will house the laboratory, tools stores as well as changing rooms and kitchen. On the other hand security fence, gates and lighting have also been provided.
- Surface water drainage structures have been designed around the waste stabilisation pond site to prevent storm water inflow into the ponds.

5.3.4. Expected Effluent quality

The sewer plant is designed to produce an efficient effluent treatment to meet these expected standards:

Table 13: Expected effluent discharge level

Raw Sludge Characteristics	Expected Values	Standard Value	Units
pH	6.5 to 7.5	6.5-8.5	
COD	<100	50	Mg/l
BOD	<15	30	Mg/l
TSS	<20	30	Mg/l
Faecal Coliform (Ni)	100 - 1000		FC/ml

5.3.5. Project activities

1. Preconstruction activities

Preconstruction activities are centred towards compliance with the law and regulation set forth. These activities include:

- Designing the project
- Getting statutory approvals from relevant government agencies i.e. county government, NEMA, NCA
- Land acquisition and compensation where necessary

2. Construction phase

Construction phase will entail the following processes:

i. Bush clearing

All bushes, plant cover, trees and shrubs along the trunk line and the site for stabilization pond will be cleared. The lead expert recommends that partial clearing should be adopted to minimize plant cover loss and biodiversity loss. The clearing should only focus on the necessary area.

ii. Excavation

The trench excavation and timbering shall be done according to requirements of relevant section of the Main Specifications. The stabilization ponds will be excavated to remove top soil and other soil and rock stratus beneath to allow space for construction of the ponds.

iii. Storage of materials

Building materials will be stored on site. Bulky materials such as rough stones, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities of materials on site, the contractor will order bulky materials such as sand, gravel and stones in quotas. Materials such as cement, paints and among others will be stored in temporary storage structures built for this purpose.

iv. Laying and Jointing

This will include levelling of the trenches to attain require gradient, joining of individual pipes to the whole pipe system and ensuring continuous flow of effluent. This will be strictly supervised by the engineer in charge.

v. Testing

Testing is a procedure to ensure that the gradient is achieved so that the waste water flow is guaranteed. It also involves testing of possible leaks and testing the joints to ensure they are leak free.

vi. Filling the trenches

The refilling of excavations shall be commenced as soon as practicable after the permanent works have been tested where so required and inspected and approved by the Engineer. No back-filling shall commence without the Engineer's authorization. In particular the back-filling of trenches shall be carried out expeditiously so as to reduce lengths of trenches open at any one time

vii. Construction of Concrete Manholes and Plot Chambers

Manholes shall be constructed on sewer lines in the positions indicated on the plan drawings or wherever that will be ordered by the Engineer.

Manholes on pipe sewers shall be constructed with an in-situ base as detailed on the drawings which shall be raised to form the benching and channels shall be carefully formed to shape according to the number, diameter and positions of the incoming and outgoing pipes. The channels in the manhole bases shall have circular inverts. The benching shall be sloped towards the channels at a gradient of 1 in 5.

viii. Construction of stabilization ponds and utility building

This will involve a lot of masonry work and structural steel reinforcements. All the materials to be used must meet engineers' standard.

3. Operation Phase Activities

The operation phase activities will involve receiving raw effluent, treating the effluent biologically and discharging the content into Ol Kalou River. There will be constant monitoring of the quality of effluent discharged by sampling and lab testing.

4. Description of the Project's Decommissioning Activities

Upon decommissioning, the project components including utility building, pavements, stabilization ponds, drainage systems, and perimeter fence will be demolished. This will produce a lot of solid waste, which will be reused for other construction works or if not reusable, disposed of appropriately by a licensed waste disposal company.

i. Dismantling of equipment and fixtures

All equipment including electrical installations, finishing fixtures partitions, pipe-work among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to reuse of these equipment in other projects. This will be achieved through resale of the equipment to other contractors or donation of this equipment to schools, churches and charitable institutions.

ii. Site restoration

Once all the waste resulting from demolition and dismantling works is removed from the site, the site will be restored through replenishment of the top soil andre-vegetation using indigenous plant species.

iii. Material Inputs

Material inputs to be used in the construction and implementation of this project are listed below.

- Building stones (machine cut and foundation type stones)
- Building sand
- Ballast
- Cement
- Timber
- Steel
- uPVC pipes
- Concrete pipes
- couplings,
- Gaskets
- Lubricants
- seals,
- Steel
- Ordinary Nails
- Damp proof membrane
- Wooden props
- Glass
- Paint
- Iron sheet
- Water
- Electrical wires

iv. Tools and Machinery

The following tools and machinery are to be used:

- Hammers and mattocks
- Wheelbarrows
- Spades, trowels and other masonry tools
- Concrete mixer
- coupling machinery
- dozers
- excavators
- wheel loaders
- backhoe
- vibrators
- and other earth movers

WASTE AND BY-PRODUCTS

The waste and by-products arising from this project include:

- Construction debris (from concrete and broken stones)
- Excavated soil
- Wooden pieces, timber cut-offs and left-over timber

5.3.6. PROJECT BUDGET

The sewer system is expected to cost Kes. 416,157,240 (Four Hundred and Sixteen Million One Hundred and Fifty Seven Thousand Two Hundred and Forty Shilling Only.

The NEMA license fee is charged at a rate of 0.1% of the total project cost will be Kes. 416,157 (Four Hundred and Sixteen Thousand One Hundred and Fifty Seven Shillings Only). The comprehensive cost estimate is as shown in table 14 below:

Table 14: Project estimated cost

Item	Description	Cost In Kes.
1.	Preliminary and general items	15,800,000.00
2.	Sewerage system within Ol-Kalou Town – main trunks	150,776,789.00
3.	Waste stabilisation Ponds	156,727,448.00
4.	Utility Building and other site works	26,325,210.00
5.	Sanitation Facilities (Public toilets)	9,126,795.00
6.	**Total project cost (Item 1 to 5)**	**358,756,242.00**
7.	Supervision cost (6% of item 6)	21,525,374.00
8.	Physical and price contingency (10% of item 6)	35,875,624.00
9.	**Grand Total Project Cost (Item 6 to 8)**	**416,157,240.00**

6. PROJECT ALTERNATIVES

6.1. SITE SELECTION

The best site for setting up of Waste Water Treatment Works would be a site that allows waste water to flow freely by gravity from the urban areas to the treatment facility. Site identification was based on previous studies done for waste water management for the Ol-Kalou town. The studies include designs prepared by Batiment Consulting Engineers.

6.1.1. Site A: Ol-Kalou Town (Proposed Site)

Field visits were conducted in 11thJuly 2016 to the proposed site. The site is relatively ideal for setting up a sewerage treatment facility as the land was set aside in the early 90s by former Ol-Kalou town Council for construction of Sewerage system for Ol-Kalou Town. The land currently is an active farm ground and waste water lagoons for Ol-Kalou, Nyandarua County. The site is considered ideal for setting up a treatment plant for that Serves Ol-Kalou Town, some of the benefits of putting up the treatment works at the point will be;

- No cases of land acquisition (or Partial land acquisition) as the land belong to Nyandarua County. This will reduce cost of land acquisition and hence the project cost. It will also help reduce conflict and court cases involved in large scale land acquisition process.
- No pumping will be required as the Sewer will flow by gravity from Ol-Kalou Town to the treatment works hence saving on energy required for pumping to the existing River Ol Kalou then final being discharge into Lake Naivasha.

6.2. TECHNOLOGY DESIGN ANALYSIS – TECHNICAL PROJECT ALTERNATIVES

6.2.1. Option 1 –`Trickling Filters Wastewater Treatment

This option entails the use of the following facilities and techniques for the waste water treatment process;

a. Fine and coarse screens for removal of large solid particles. This will be provided so as to remove from the sewage gross solids, such as rags, timbers, maize cobs, etc. This will ensure that blockages or damage to the subsequent pipes and treatment

processes do not occur.

A 100mm clear opening coarse screen will precede a 25mm clear opening fine screen. So as to reduce the costs of construction, operation and maintenance, hand raked (manually operated) screens will be provided placed at an angle of 45^0 from the horizontal.

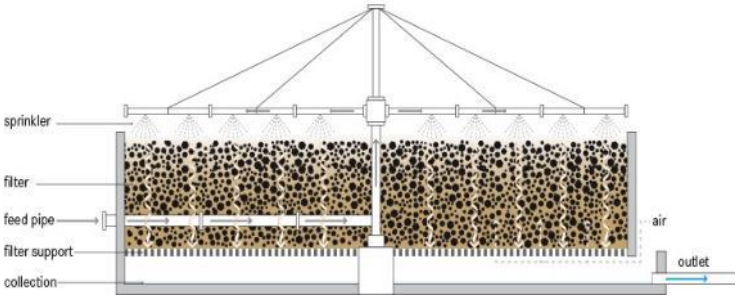


Figure 4: Trickling Filters Wastewater Treatment

b. The waste will then pass through a grit chamber where mineral matter will be removed by the process of settlement of heavier particles due to the reduction of the flow velocity hence increment of the settling velocities of the heavier particles. Grit removal is vital in that it ensures that reduced wear on machineries and attrition of pipeline linings, it facilitates sludge treatment and handling, and also prevents excessive accumulations of grit in tanks, pipework and channels.

c. Primary sedimentation will be applied so as to effect reduction of the organic load to the facility by removal of sludge (sludge is the one responsible for the high levels of organic loading in the sewage) by a similar process as for the grit removal.

d. Once removed, the sludge will be processed by using anaerobic sludge digesters and open-air sludge drying beds. Here, pumping might be necessary.

e. The remaining effluent from the primary sedimentation will be passed through a trickling filter unit.

f. The effluent of the trickling filters will be directed to a humus (secondary sedimentation).

g. Due to the stringent environmental management standards that are becoming tighter day after day, a constructed wetland is proposed as a final waste treatment for this alternative.

h. The technology is highly mechanical, therefore the client should ensure the availability of spare parts for machinery installed, availability of the software in the market for computerized system and adequate regular training of the operator.

This option can achieve the highest removal of pollutants in the waste stream compared with the other options and requiring the lowest land requirements. The possibility of generating electricity through the capture of methane could lead to revenue from carbon credits and sale of electricity to the grid. This option will be explored.

6.2.2. Option 2 – Waste Stabilization Ponds

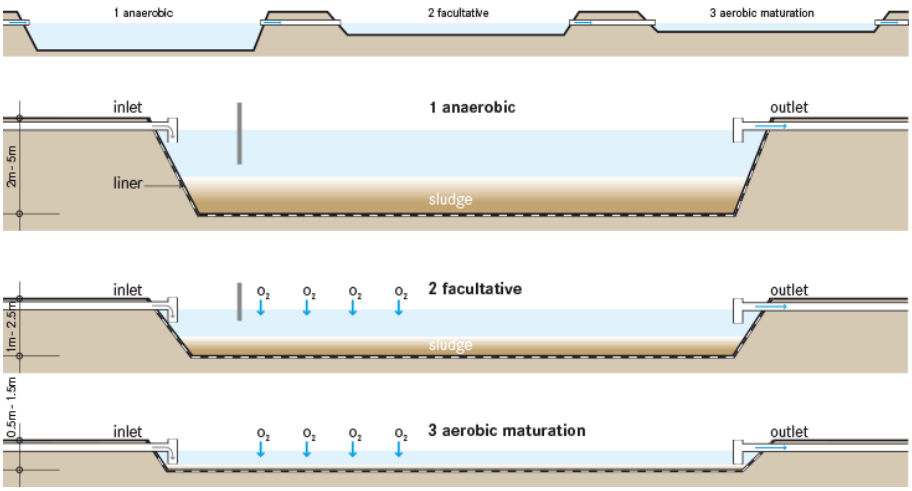


Figure 5: Waste Stabilization Ponds

The waste water stabilization Ponds is multi-cell system comprises of three types of ponds; anaerobic ponds, Facultative ponds and Maturation ponds.

Anaerobic and facultative ponds are primarily designed for BOD removal and maturation ponds are for pathogen removal. Anaerobic ponds also reduce nutrients and pathogenic microorganisms by sludge formation and the release of ammonia into the air.

This option entails the following facilities and techniques for the waste treatment process;

a. Fine and coarse screens for removal of large solid particles. This will be provided so as to remove from the sewage gross solids, such as rags, timbers, maize cobs, etc. This will ensure that blockages or damage to the subsequent pipes and treatment processes do not occur. A 100mm clear opening coarse screen will precede a 25mm clear opening fine screen. So as to reduce the costs of construction, operation and

maintenance, hand raked (manually operated) screens will be provided placed at an angle of 45^0 from the horizontal.

b. The effluent of the screening process will be emptied into a waste stabilization ponds system. This will consist of anaerobic ponds, facultative ponds and maturation ponds.

c. Due to the stringent environmental management standards that are becoming tighter day after day, additional polishing ponds are proposed as final waste treatment technique. These are proposed due to their cost effectiveness as compared to the other options.

d. The design of the system should ensure that the ponds are well accommodated by the land set aside.

This option is highly cost effective in term of construction, operation and maintenance costs. If well designed, at the prevailing environmental conditions in the project area, this can be a very effective system in pathogen removal.

It is limited by the land requirements which tend to be more compared with the conventional system but lesser compared to the constructed wetlands options.

6.2.3. Option 3 – Constructed Wetlands

The third option entails the use of constructed wetlands to treat the waste water after preliminary screening and grit removal. This comprises of:-

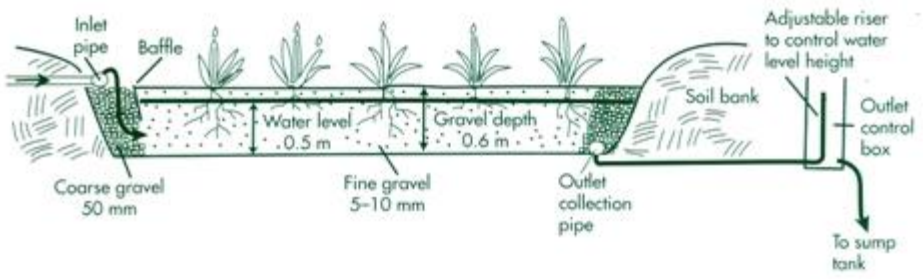


Figure 6: Constructed Wetlands

a) Screening to remove the large solid materials;
b) Grit removal by use of a horizontal flow grit chamber;
c) Subjecting the effluent of the pre-treatment process to a Free Water Surface (FWS) system of constructed wetland, where the flow of water is above the ground, and plants are rooted in the sediment layer at the base of water column.

This option is highly preferred since it is eco-friendly and can remove a number of pollutants including organic materials, suspended solids, nutrients, pathogens, heavy metals and other toxic or hazardous pollutants. Different types of this system can be used effectively to treat primary, secondary or tertiary sewage.

This option is a practical alternative to the conventional treatment of sewerage but not to the waste stabilization ponds.

This option is disadvantaged in that it requires a very big space of land for the treatment process. This option also requires thorough operation and maintenance activities therefore making the operation costs very expensive. The capacity of the wetlands to treat wastewater is limited, both in terms of the quantity of water, and the total quantity of the pollutants. Also, the chemical and biological processes occur at a rate highly dependent on environmental factors, including temperature, oxygen and pH. A slight change in the above parameters greatly affects the treatment process.

6.2.4. Option 4 - Septic tanks

Septic tanks are commonly found in rural and suburban areas where populations are low. Because septic drain fields require a particular amount of space for both the tank and the septic drain field, septic tanks are not ideal in densely populated areas. The size of the tank is determined by how many users are connected to the system. Existing guidelines stipulates septic tank for up to 400 persons or approximately 80,000 litres. Septic tanks rely upon a certain amount of naturally occurring bacteria to help break down the solid waste. Household chemicals, prescription drugs and other toxins like pesticides can damage the levels of bacteria.

A septic tank generally consists of tanks of varying size, depending on the population serves, which is connected to an inlet wastewater pipe at one end and a septic drain field at the other. These pipe connections are generally made via a T pipe which allows liquid entry and egress without disturbing any crust on the surface. Today the design of the tank usually incorporates two chambers (each of which is equipped with a manhole cover) which are separated by means of a dividing wall which has openings located about midway between the floor and roof of the tank.

This option will involve individual or clustered plot owners constructing standard septic tanks for liquid waste management. They will then be making subsequent arrangements with utility operator

to be draining the septic tanks periodically. This proposal will entail setting up a monitoring system to ensure that prompt draining of the tanks is carried out.

Apart from the financial implications of this alternative, there are a number of environmental and operational problems that militate against this alternative. Operational problems associated with septic system include the following among others:

a. Excessive dumping of cooking oils and grease can fill up the upper portion of the septic tank and can cause the inlet drains to block. Oils and grease are often difficult to degrade and can cause odour problems and difficulties with the periodic emptying.
b. Flushing non-biodegradable products such as sanitary towels, cloth, plastic bags / paper, polythene materials, wood, and cotton buds may rapidly fill or clog a septic tank
c. Excessive water entering the system will overload it and cause it to fail.
d. Even well maintained septic tanks release mucus-producing anaerobic gut bacteria to the drainage field. The mucus "slime" will slowly clog the soil pores surrounding the drain pipe and percolation can slow to the point where backups or surfacing effluent can occur. This slime is called biomat and such a failure is referred to as "Biomat failure".
e. Trees in the vicinity of a concrete septic tank have the potential to penetrate the tank as the system ages and the concrete begins to develop cracks and small leaks. Tree roots can cause serious flow problems due to plugging and blockage of drain pipes, but the trees themselves tend to grow extremely vigorously due to the continuous influx of nutrients into the septic system.

Challenges of septic tank

- Biggest practical size is approximated at 80,000 litre and hence not appropriate for large scale public use
- Operational and maintenance details and risk of leakage at varied location
- Its effectiveness heavily depends on soil types
- Inefficient in rainy seasons since the soil soaking surface get saturated by rain water

Advantage

- It is ideal for serving isolated cluster settlement
- It is cost effective for small scale users

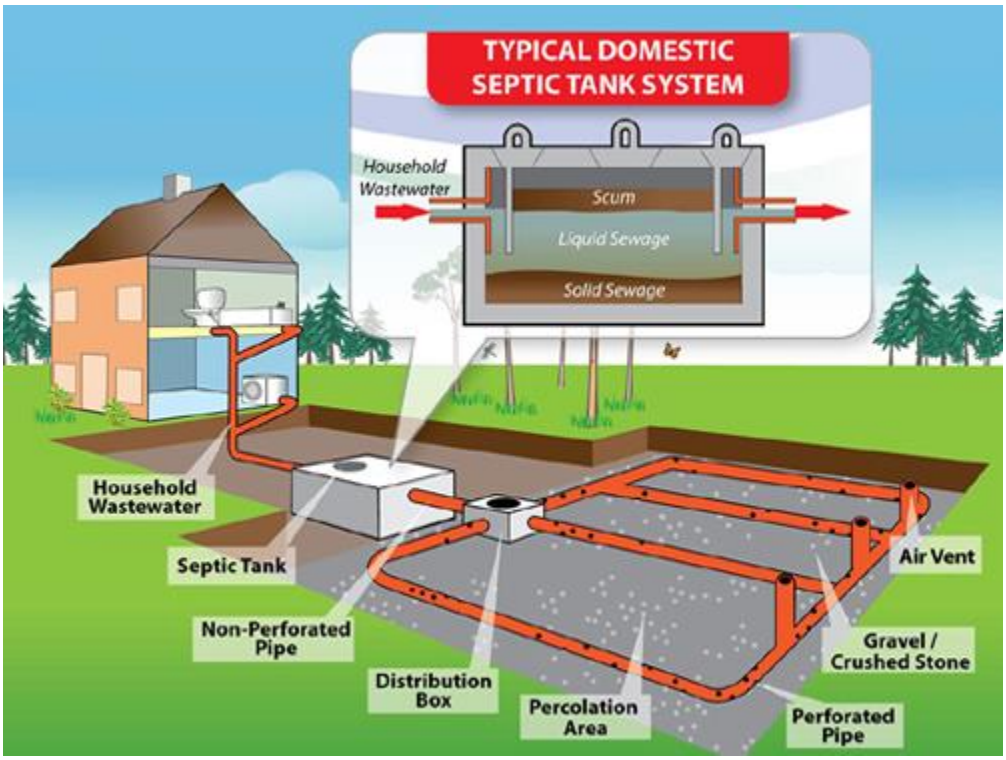


Figure 7: Septic tanks

Apart from the above mentioned operational problems associated with a septic tank, there are several environmental problems that result from the use of this wastewater treatment technology. Some pollutants, especially sulfates, under the anaerobic conditions of septic tanks, are reduced to hydrogen sulfide, a pungent and toxic gas. Likewise, nitrates and organic nitrogen compounds are reduced to ammonia. Because of the anaerobic conditions, fermentation processes take place, which ultimately generate carbon dioxide and methane. The fermentation processes cause the contents of a septic tank to be anoxic with a low redox potential, which keeps phosphate in a soluble and thus mobilized form. Because phosphate can be the limiting nutrient for plant growth in many ecosystems, the discharge from a septic tank into the environment can trigger prolific plant growth including algal blooms which can also include blooms of potentially toxic cyanobacteria.

Soil capacity to retain phosphorus is large compared with the load through a normal residential septic tank. An exception occurs when septic drain fields are located in sandy or coarser soils on property adjoining a water body. Because of limited particle surface area, these soils can become saturated with phosphate. Phosphate will progress beyond the treatment area, posing a threat of

eutrophication to surface waters. In areas with high population density, groundwater pollution levels often exceed acceptable limits. This is a likely scenario if this technology is to be pursued.

6.3. FINAL EFFLUENTS DISPOSAL METHODS

6.3.1. Effluent disposal

Among the existing options for the final waste disposal after treatment, the most economical, environmentally and financially sound option is the disposal of the final effluent from the treatment works of Ol-Kalou town, Nyandarua County into Ol Kalou River a tributary of River Malewa then into L. Naivasha. This is the most cost effective method of disposing of the waste as opposed to ground water recharge or irrigation.

An outfall trunk sewer will be used to dispose the effluent to the river at a point away from domestic and livestock water abstraction points. However, the treated water will have a low BOD which will be further reduced through the process of dilution.

6.3.2. Sludge disposal

The treated and dried sludge may be disposed of by using it to fertilize lands in the nearby farms for growing maize, beans potatoes and vegetables. Composting of the sludge will be an appropriate way of adding nutrient value to the sludge prior to use in the agricultural activity. Green solid waste, i.e. organic waste from plants like food left-overs and throw-away, can be very good materials for blending the fertilizer.

6.4. NO PROJECT ALTERNATIVES

Under the "No Project" alternative, the proposed project shall not be constructed. This would mean that the negative impacts associated with poor wastewater management within Ol-Kalou Town will continue.

This alternative would also mean that the resultant socio-economic benefits that would accrue from the proposed development would be foregone. Looked at from the point of view of the benefits that are likely to accrue to the general public in terms of revenue and taxes to the National

Government and County government, and employment opportunities to the local people, this alternative is not recommended.

6.5. COMPARISON OF ALTERNATIVES

From the above discussion, four alternative technologies have been considered and their relative merits discussed.

The technologies include Conventional Wastewater Treatment; Waste Stabilization Ponds; Constructed Wetlands; Septic tanks and the "No project" alternatives. Based on the various disadvantages of other options that has been discussed above, both convectional waste water treatment plant and Waste Water Stabilization Ponds are ideal for the proposed Ol-Kalou Sewerage System, the client should ensure that the cost of setting up each technology is cost effective as analysed in the inception report. However, due to low operational cost of the waste water stabilization pond, this option becomes the most viable option economically, in terms of practical viability and ease of implementation and operation.

7. PUBLIC CONSULTATIONS

Public consultation plays an important role in gathering social and environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans. It allows an open participatory approach in the planning of projects and consultation with Interested and Affected Parties (IAPs).

Public consultation in the ESIA process is undertaken during the project design, implementation and initial operation. The aim is solicit views from the project affected persons and key stakeholders and consulting on sensitive issues regarding the project. Further, public participation assists in making informed decision thus enhancing accountability thought the project.

Lack of public participation may results to significant informational gaps during environmental and social impact assessment. If information is not communicated to project affected persons it can lead to the community opposing the proposed project and as a result substantial delays, increased costs, and unsatisfactory compromise solutions, which could have been avoided through earlier consultation. Participation is therefore a process through which different stakeholders influence and share their views regarding development initiatives and the decisions and resources that affect them.

It is quite evident that the effectiveness of resettlement programs is directly related to the degree of continuing involvement of those affected by a project. Comprehensive planning is required to ensure that local government, NGOs, project staff and affected men and women (displaced and host) interact regularly and purposefully during all stages of the Project. The participation of different social groups directly affected by a project is a prerequisite of resettlement planning. The involvement of the Project Affected Persons (PAP) in the design of the mitigation and/or resettlement plan increases the probability of success.

Public consultation process for the Ol' Kalou Sewerage Project took place at the ESIA stage. The main objective of the consultation process was to involve the community at the very early stage so as to identify likely negative impacts and finding ways to minimize these negative impacts. The consultation also identified positive impacts and ways to enhance these impacts for the good of the community.

7.1. OBJECTIVES OF THE PUBLIC CONSULTATION

An important element in the ESIA process is seeking and gathering information that will enable successful completion of the assessment.

The overall goal for the consultation process was to disseminate project information and incorporate the views of the Project Affected Persons (PAPs) in the design of the mitigation measures and management plan as well as in the preparation of the resettlement Action Plan for the Ol' Kalou Sewerage Project.

The specific aims of the consultation process during the ESIA stage were;

- To inform the local people, leaders and other stakeholders about the proposed Ol' Kalou Town sewerage Project and its objectives
- Obtain the main concerns and perception of the community and their representatives regarding the project
- Obtain opinions and suggestions from the directly affected persons on the project impacts and best suited measures
- To improve on the project designs and therefore minimizing conflicts and delays in implementation
- To facilitate the development of appropriate and acceptable entitlements options
- To increase long term project sustainability and ownership
- To reduce problems of institutional coordination, especially at the different governments levels.

7.2. STAKEHOLDER CONSULTATIONS DURING FIELD RECONNAISSANCE

The study team held introductory meeting with various key stakeholders at the field reconnaissance study on 11th July 2016. These meetings served as introduction to the Ol Kalou Sewerage project and set the ground for the ESIA and RAP studies.

The main issues of concern at this stage were identification of crucial issues for further consultation during the ESIA study.

7.2.1. Summary of issues rose

Date	Consultation With	Designation	Outcome
11/7/2016	Eng. Martin Kamami	Chief Officer: Water, Environment and natural resources- Nyandarua County Government	- Supportive of the sewerage project - The current status of liquid and solid waste management is undesirable for the county - Disposal site in some of the areas within the county have been closed down due to public health concern - Compensation and settlement of affected people need to be addressed
	Julius Maina	Managing Director-Ol' Kalou Water and Sewerage Company	- -There is no sewerage system in place in Ol' Kalou Town - OLWASCO water pumped is between 12,000M3 a day against the current water demand of 16000m3 a day - The company has no water reservoir water is pumped directly to the users - The establishment of the sewer system in Ol Kalou will be of key importance to OLWASCO and it is anticipated this will improve

		the company ranking in the Performance review by WASREB
Amos Maina	Public Health Officer- Nyandarua County	- Water borne diseases are reported in the town especially during rainy season - Leaching occurs during the rainy season - Hospital has its lagoon for their liquid waste - The hospital has its own designated solid waste disposal sites

7.3. PUBLIC CONSULTATIONS

A total of two public community meetings were held in the help of local administration. The breakdown of the meeting held is as shown below;

Table 15: public consultation meetings

NO	DATE	TIME	VENUE
1.	Friday 5th August 2016	9.00 a.m.	Ol Kalao town Railway Grounds

2.	Friday 2016	5th	August	2.00 p.m.	Proposed site area

7.3.1. Objective of the public consultation meetings

The following were the objectives of the meeting;

- Awareness creation about the project to the community with respect to scope of the project; stakeholders of the project; development approach to be employed in the project; roles and responsibilities of the community and other stakeholders and role of Batiment Engineering and Associates in the project;
- Informing the community about the anticipated project management structure in relation to effective project operation;
- Explaining to the community on the different activities the study team will be undertaking
- Informing the community on the environmental and social impacts of the project will be addressed;
- Getting feedback from the communities on their views on the project and issues of concern;
- Inclusion of the community in the development of the project at the planning stage;

7.3.2. Issues and concerns raised by IAPs

A summary of the comments on the Ol' Kalou Town Sewerage Project raised from the public meeting is presented in the following sections. Minutes for the public meetings are presented in Appendix of this report.

i. Employment Opportunities

The youth complained of lack of employment opportunities within the town. They lamented that most time when such projects of high magnitude are set to be constructed the youth in the area are left out in favour labour from other areas.

It was proposed that RVWSB define what measures will be put in place to ensure that contractors do not source for labour from other area and how they will ensure the youth of this area are given priority when it comes to employment opportunities.

It was recommended that the project proponent is to ensure that the youth in the area are given priority when it comes to job employment.

ii. Compensation of the PAPs

The community raised the issue of compensation especially when the sewer trunk passes through their piece of land. The Study team responded by informing the meetings that the reason we are conducting the RAP is to identify, inform and collect concerns from those affected.

Nonetheless, in case of any resettlement whatsoever, the right and legal procedure will be adhered to for the same. There will be proper communication on the specific affected parcels after the survey. The full details of resettlement and compensation is defined in the RAP reports.

iii. Possible flooding/ damage due to excess water

Concerns of the possibility of flooding at proposed site once the project is implemented were raised. The excess water may cause damage to crops and possibly cause injury or fatality in the case of children in the area.

The study team responded by stating that the drainage area with the project site area will be enhanced to ensure that there is no possible flooding resulting from the project

7.4. SUMMARY OF STAKEHOLDERS COMMENTS

AREA OF CONCERN	ISSUE RAISED	ISSUE ADDRESSED
Water quality	✓ There were concerns that with the current disposal mechanism in place, there is seepage and some of the liquid waste is finding its way into the nearby river. How will water quality be ensured before discharging water into the rivers once the project is completed? ✓ Water borne diseases are predominant especially among the individuals near the proposed site. How will the project address this issue	✓ One component of the project is a laboratory. Therefore, before discharging water into the river the water will undergo various tests to ensure its standards comply with the WRMA effluent discharge standards. ✓ Currently, there is no sewer system within the town and therefore it is anticipated in the event that the project is completed reported cases of water borne diseases will be minimal
Project design	✓ The project was design in 2012 when the town had not acquired the status of the county headquarter. How will the project address increased in demand due to population and infrastructural growth?	✓ The project design will be reviewed to ensure that it accommodate the anticipated population growth and infrastructural influx ✓ The RVWSB will call an expression of interest on the project design revision
Project duplication	✓ The county government of Nyandarua is currently undertaking some construction works for an aerobic treatment plant to ease the current liquid waste status in the county. Is this duplication of project between the RVWSB and the county government?	✓ The current construction works is just meant to ease the current situation of liquid waste disposal in the town. Once the proposed project commences, the construction work will be integrated to the project to form a more sustainable solution to liquid waste management in the site.
Project implementation	✓ Once the project is completed who will be the custodian?	✓ The project will be handed to Ol' Kalou Water and Sewerage Company. OLWASCO will manage all operations of the project after its implementation.

Proposed project Impacts	✓ One of the project impacts is creation of employment opportunities. How will you ensure that the contractors do not source for labour from other counties? ✓ How will solid waste be managed ✓ How will the people who have genuine title deeds within the project site be compensated and also those individual who will have the sewer trunk passing through their premises?	✓ ESIA report will recommend that the project proponent ensures that the contractor give first priority to residents of the town based on employment opportunities ✓ It is recommended that a perimeter fence be put in place to ensure that unauthorised individuals do not access the premises. ✓ One of the components of the ESIA is to develop a resettlement action plan, which will identify the exact number of project affected persons and proposed a budget for their resettlement plan.

7.5. PROJECT SUPPORT

The implementation of the sewerage project will have a far reaching effect on the social life of the people living within and around the project area. The public 98.45% of the respondents from the issued questionnaire were in agreement that they support the project as described in table 11

Table 16: project support

PROJECT SUPPORT	
Support project	Percentage Response
Yes	98.45%
No	1.55%
Total	100%

8. IMPACTS ASSESSMENT AND PROPOSED MITIGATIONS

On-site and off-site impacts can be induced during the construction of the sewerage treatment system, during its operation and decommission phase. On-site impacts result from construction activities carried out within the construction site. The impacts of off-site work result from activities carried out outside the construction site yet are directly related to the project. The new sewerage treatment system could have potential significant impacts but appropriate measures can be put in place to mitigate these impacts.

Identification of potential impacts was facilitated by the use of a checklist that considered the main activities at the proposed project, the major perturbation factors, and the environmental media affected. The extent of impacts from the sewerage treatment plant will depend primarily on the site location, soil and geology of the site, sewerage treatment method and effluents management practices that would be adopted during plant operation.

8.1. IMPACT ASSESSMENT SCORING

Table 17: Assessment criteria for significant impacts

Key	Type of impact	Key	Type of impact.
++	Major positive impact.	+	Minor positive impact.
- -	Major negative impact	-	Minor negative impact.
0	Negligible/zero impact	NC	No change
Sp	Specific/localized	W	Widespread.
R	Reversible	Ir	Irreversible.
Sh	Short term.	L	Long term.
T	Temporary	P	Permanent

On the basis of information gathered during both the desktop and field study, the potential environmental impacts of the proposed project are as tabulated below.

Table 18: Potential Environmental Impacts

IMPACTS ON OR DUE TO	CONSTRUCTION	OCCUPATION	REMARKS
Noise Pollution	**-**	**0**	▪ During construction, hooting of construction vehicles and communication from workers may generate noise and vibration that may have negative effect to the neighbourhood. This will however be very minimal and will be restricted to the construction stage of the project.
Oil waste pollution.	**-**	**-**	▪ Petroleum oils and grease used in vehicles and construction machinery may spill or leak on/into the ground hence into the soil or water system within the neighbourhood ▪ Oil waste will not be a major issue during operation phase of the project.
Air/Dust Pollution	**-T, R**	**-**	▪ During construction, dust and exhaust emission from the construction activities and machinery, may Pollute the ambient air. ▪ In severe cases, this may cause visual intrusion
Soil erosion	**-T**	**0**	▪ Earth works during project construction usually influence soil erosion. By incorporating appropriate soil conservation measures and proper drainage facilities both during construction and operation phases of the project, soil erosion will be completely minimized.
Public Health	**-**	**-**	▪ During the construction process, there will be health threats to workers on site. ▪ During operation phase, public health threats will be from blocked Sewerage system that may pollute the environment

Flora and fauna	**P**	**-**	•	Removal of overburden during excavation w permanent removal of vegetation on affected sit
			•	Small animal, insect, warms and rodents living on a will have their habitat and life destroyed
Nuisance impact	**-SH**	**0**	•	There will be increased traffic along Ol Kalou- Gi access roads leading to the site caused by lorri construction materials to the site

8.2. POSITIVE IMPACT OF CONSTRUCTING THE SEWERAGE TREATMENT PLANT AND SEWER LINE

8.2.1. Employment opportunities

One of the main positive impacts during projects construction phase is the availability of employment opportunities especially to casual workers and several other specialised workers. Employment opportunities are of benefit both economically and in a social sense. In the economic sense it means abundant unskilled labour will be used in construction hence economic production.

Several workers including casual labourers, masons, carpenters, joiners, electricians and plumbers are expected to work on the site from start to the end. Apart from casual labour, semi-skilled and unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction.

8.2.2. Improving growth of the economy

Through the use of locally available materials during the construction phase of the project including cement, concrete, timber, sand, ballast electrical cables etc, the project will contribute towards growth of the economy by contributing to the gross domestic product. The consumption of these materials, fuel oil and others will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

8.2.3. Boosting of the informal sector

There are usually several informal businesses which come up during the construction periods of such projects. These include activities such as food vending who benefit directly from the construction staff members who buy food and other commodities from them. This will promote the informal sector in securing some temporary revenue and hence livelihood.

8.3. NEGATIVE IMPACT DURING CONSTRUCTION

8.3.1. Loss of vegetation

Most of the planted trees at the proposed site will be cleared to pave way for excavation and lying of the foundation of the proposed sewer treatment plant and sewer trunk, paved walk ways, parking and the associated building to be constructed. Moving vehicles, machines and people used to ease the construction work will create additional damage to vegetation by their movement on the plants. The pressure to be exerted on the plants by the heavy vehicles, machines and people may interfere with biological processes in the plants alongside leading to death of the plants. It is unlikely that there are soil dwelling organisms at the proposed site. With the removal of fauna, the following effects are likely to occur:

Several species of plants and animals are threatened with extinction though on a localized scale. Loss of valuable food and shelter for arthropods whose life is depended on plants at the proposed site for shelter and food leading to their eventual death and/or displacement.

- Soil erosion and siltation.
- Alteration or destruction of habitats of animals due to clearing of plants.

M*itigation*

It is impossible to totally avoid vegetation removal and disturbance during the construction phase. It is however important to ensure that any flora and fauna removal and disturbance is restricted to the actual project area to avoid spill-over effects to neighbouring areas and that the same are restored by:

- Properly demarcating the project area to be affected by the construction works.
- Strictly controlling construction vehicles to ensure that they operate judiciously and over designated areas to minimize destruction of vegetation.

- Re-establishing vegetation in some parts of the disturbed areas through implementation of a well-designed landscaping programme by planting of ornamental trees, flowers and hedges.

8.3.2. Soil erosion

Vegetation clearance, excavation works, and pond construction works will expose soils in the affected project areas leaving them vulnerable to erosion by surface run-off and ultimately siltation of adjacent stream waters. Such conditions are only likely to occur during periods of intense rainfall which is characteristic of the area during the long rains (April to June) and particularly during the laying of the sewer trunks. The flat topography of treatment pond's site will greatly reduce erosive surface flows during construction of the treatment ponds.

Mitigation:

- To the greatest extent possible, plan to do the construction work during the short rains to minimize the exposure of loose soil to surface runoff.
- As much as it's practically possible, phase site clearance so as to minimize the area of exposed soil at any given time.
- Back fill and compact excavated areas as soon as the laying of trunks is done

8.3.3. Soil compaction

As machines and people move on ground the soil is compacted. Compaction has the undesired effect of hindering air and water penetration beneath the soil surface and thus limiting aerobic activities of soil dwelling organisms. This may have negative consequences on soil productivity on a localized scale. Compaction also enhances run-off during the rainy season resulting into soil erosion.

Mitigation

- Strictly control construction vehicles to ensure that they operate judiciously and over designated areas to reduce soil compaction.
- Rip off any compacted areas after construction to allow aeration of soil and ease infiltration of water into the soil.

8.3.4. Alteration and/or destroys habitats of organisms

Excavation alters and/or destroys habitats of organisms. It also creates loose soils making it prone to both water and/or wind erosion. Soil erosion causes disturbance in soil quality and

structure on a localized scale and results into siltation of water bodies receiving the run-off and eventually flooding in the lower areas.

Mitigation

- Properly demarcate the project area to be affected by the construction works to avoid spill over effects to neighbouring areas.
- Carry out all excavation works as instructed in the approved architectural plans for the sewer plant and trunk

8.3.5. Nuisance dusting

It is anticipated that a certain amount of air borne particulate matter (dust) will be generated by earth moving activities during pond construction and during excavation of trenches for the sewer trunks. This situation will be worse during the dry season and during the afternoons when the winds are most prevalent. Air borne particulates may pose a hazard to residents in the vicinity or downwind of the construction site that suffer from upper respiratory tract problems. Otherwise it may only be a nuisance. The impact of dusting is short-term, lasting for the duration of the construction activity.

Mitigation:

- To the greatest extent possible, plan to do the construction work during the short rains to minimize the generation of dust.
- During dry and windy conditions, access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust
- Workers on the site should be issued with dust masks during dry and windy conditions.

8.3.6. Noise and vibrations

Noise is unavoidable during the construction period. The construction works will most likely be a noisy operation due to the machines (mixers), incoming vehicles to deliver construction materials and communication among workers. The noise generated during any construction is at best described as part of a normal occupational hazard that workers in the construction industry face. Noise levels in construction works are usually below the threshold limit (90 dBA) that workers can be exposed in an 8 hours working day and is consequently not of any major concern. Operations and people in the neighbourhood are likely to be affected since noise beyond 85 dBA (can be transmitted up to 30 metres away) is itself a nuisance. The significance of noise impacts depends on whether the project would increase noise levels

above the existing ambient levels by introducing new sources of noise. Noise and vibration impacts would be considered significant if the project would result in: a substantial permanent increase in ambient noise levels of more than 90 dBA (can be transmitted to over 30 metres away) in the project vicinity; exposure of persons to or generation of excessive ground-borne vibration or noise levels and a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The effects of noise include:

- Noise interferes with communication and can lead to tinnitus (ringing in the ears);
- Nuisance;
- Fatigue and tiredness, reduced efficiency, low morale and severe and permanent loss of hearing which may persist for several hours due to prolonged exposure to noise;
- Deterioration of the environment within the project site and the surrounding areas through vibrations produced by heavy construction machinery;
- Weakening of adjacent buildings resulting into cracking of their walls by vibrations.

Mitigation

Adhere to the Kenya Noise Prevention and Control rule passed in 1996 under legal notice No.296 as a subsidiary legislation to the Occupational Health and Safety Act (OSHA) of 2007 which requires putting in place measures that will mitigate noise pollution. Consider especially the rule which states that, "No worker shall be exposed to noise level in excess of the continuous equivalent of 90 dBA for more than 8 hours within any 24 hours duration".

a) Minimize noise at the site and in the surrounding areas through:
   - Sensitization of truck drivers to switch off vehicle engines while offloading materials;
   - Instructing truck drivers to avoid running of vehicle engines or hooting especially when passing through noise sensitive areas such as religious areas, hospitals and schools;
   - Properly servicing and maintaining and tuning construction machinery such as generators and other heavy duty equipment to reduce noise generation; and
   - Placing noisy equipment in sound proof rooms or in enclosures to minimize ambient noise levels.

b) Minimize the impacts of temporary construction noise and vibration by:

- Planning the construction work to take place only during the day when the neighbours are also at work.
- Maintaining reasonable working hours so as to reduce the number of complaints concerning noise from the workers and neighbours.
- Operating shorter shift periods for workers who come in direct contact with high concentrations of noise or other hazards.
- Posting notices at the construction site informing the public of the construction activities, time and day.
- Providing ear protective devices to prevent high frequency noise emitted by the high frequency machines during construction phase.

8.3.7. Construction wastes and pollution

Potential sources of pollution at the construction site may include:

a) Spillage of paints, oils, cement and chemicals;

b) Improper disposal from the site of liquid and solid wastes including excess excavated soil;

c) Uncontrolled burning of wastes;

d) Pieces of waste timber, polythene papers, metals, glasses and tins among other wrapping materials;

e) Dust from the excavation, stone crushing and shaping areas and from trucks carrying construction materials and

f) Exhaust emissions from automobiles including trucks that come in and out of the site and possible burning of wastes at the site. The emissions may contain contaminants such as nitrates (NO_X), carbon-dioxide (CO_2), sulphates (SO_X) and lead (PMB_{10B}).

Mitigation

a) Implement a standard set of feasible dust control measures at the site such as:

- Covering all trucks hauling soil, sand and other loose materials and/or require these trucks to maintain at least two feet of freeboard;
- Watering all dust-active construction areas to suppress dust emissions; and
- Paving or applying water when necessary or applying non-toxic soil stabilizers on all unpaved access roads and parking areas.

b) Reduce exhaust emissions by implementing the following:

- Advice drivers at the site to minimize vehicle idling time;
- Properly tune all equipment and maintain them in good working conditions; and
- Properly plan the transportation of materials and ensure that vehicle fills are increased so as to reduce the number of trips done and the numbers of vehicles on the roads.

c) Handle chemicals and other potential pollutants carefully and appropriately.

d) Have a fully equipped first aid kit at the site at all times and ensure that trained first aid personnel are available to handle any incidents due to pollution at site.

e) Provide all construction workers with personal protective equipment (PPE) including masks, goggles, scarfs, boots and overalls among other protective clothing as spelt out under section 101 (1) of OSHA 2007.

f) Reuse or recycle some materials which may be considered as waste or give them to people who may consider them useful for others uses.

8.3.8. Impacts on Public and Occupational Safety and Health

In any civil works, public as well as construction staff safety risks can arise from various constructions activities such as deep excavations, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, disturbance of traffic, and exposure of workers to running sewers. Because of the short duration and non-complexity of the construction phase, such activities are controlled and consequently the associated risks are minimal. Proper supervision, high workmanship performance, and provision of adequate safety measures will suppress the likelihood of such impacts on public and occupational safety.

8.4. POTENTIAL POSITIVE IMPACTS DURING OPERATION

There are a number of positive benefits associated with the proposed project. They include the following:

- There is significant positive impact to be gained through elimination of discharges of untreated sewage to the Ol Kalou River, and this (assuming suitable mitigation measures are incorporated) far outweighs any other negative impacts associated with the proposed development.

- The project will provide wastewater management infrastructure for Ol-Kalou Town. This will lead to environmental conservation and management as pollution from septic tank leakages will be eliminated.
- Provision of employment opportunities during both construction and operation phases of the project.
- The proposed project will centralize the town's wastewater treatment and will make pollution monitoring easy and more effective.
- Step towards realizing vision 2030. This will be achieved due to the fact that potential investors will develop the region as they will be guaranteed of good infrastructure of sewer disposal.
- Improved health of the people- Reduced cases of respiratory and water borne diseases associated by poor sanitation due to poor domestic waste water management.
- Improved water quality in of Lake Naivasha.
- Improved aesthetic value of the area due to cleaning up of the mess that is currently experienced in Storm water drains in the towns.
- Creation of job opportunities during implementation phase for the plant operators
- Sludge from the WWTW is a rich resource that can be utilized by the community around as fertilizers, but Ol 'Kalou water and sewerage Company should put stringent measures to ensure that no effluents from industries are disposed into the sewer system before pre-treatment. Community sensitization and enlightenment is also needed to ensure that the communities accept use of human wastes as fertilizer.

8.5. NEGATIVE IMPACTS DURING OPERATION PHASE

8.5.1. Contamination of Water Resources

Contamination of drinking water sources by sewage can occur from raw sewage overflow, leaking or burst sewer lines, land application of sludge and partially treated wastes. Sewage in itself is a complex mixture and can contain many types of contaminants. The greatest threats posed to water resources arise from contamination by bacteria, nitrates, metals, trace quantities of toxic materials and salts. Sewerage seepage into drinking water sources can cause disease from ingestion of pathogenic microorganisms. Additionally, flooding of the wastewater as well as leakage from the treatment ponds can threaten groundwater resources.

Mitigation

- The treatment pond should be made as impermeable as practically possible in order to prevent possible contamination of ground water or shallow wells in the area. The sewer line will be regularly inspected and maintained in order to safeguard against sewer line blockages and bursts.
- Monitor the quality of effluent will be on a daily basis. Effluent quality analysis reports will be submitted to NEMA on a quarterly basis. Proper operation of the entire sewerage treatment system will be ensured and monitored for deviations to guarantee that effluent from the treatment pond meets the required standards. The water quality of the receiving streams will be monitored to check on changes on its quality.
- To prevent flooding into the ponds, a properly made embankment should be constructed around the ponds to prevent storm water mixing with sewer, since this may fill up the treatment ponds casing overflow

8.5.2. Odour

Whereas one of the main sources causing odour is scum, overloading of the ponds will also result in odour problems because the treatment capacity will have been exceeded. Wind action on the ponds can also cause odours. Odour is best controlled by proper design and the nuisance risk is reduced by proper alignment of the ponds. The size of the ponds will result in some degree of wave action. The wind is the effective source of aeration through surface mixing, but too much wind action can disturb bottom sediments and create an odour problem.

Mitigation:

- Ensure proper sizing and alignment of the lagoons
- Ensure scum is properly stabilized.
- Plant a strip of fast growing tree species around the ponds

8.5.3. Flood Hazard

The low lying flat nature of the site and proximity to the adjacent stream makes the site susceptible to flooding. Flooding may lead to discharge of raw sewage from the treatment ponds to the adjacent stream.

Mitigation;

- Designed surface water drainage structures around the waste stabilization pond site to prevent storm water inflow into the ponds.

8.6. NEGATIVE IMPACTS CROSS-CUTTING BETWEEN CONSTRUCTION AND OPERATION PHASES

8.6.1. Increased traffic flow

During the construction, there will be an influx of traffic to and from the proposed construction site. There will be increased movement for both vehicles and people on the existing access roads near the site. Vehicles especially those to be used in facilitating the construction work for example transportation of construction materials and/or construction workers or supervisors to the site. People coming to the site will include those seeking employment opportunities, workers, managers, environmental inspectors and suppliers of foodstuffs to the construction workers. Though increased traffic during construction is a short term impact, it has the effect of causing congestion on the access roads which may subsequently results in accidents on the roads.

During the operation phase, traffic flow will increase due to the increase in number of people visiting the premises and distribution vehicles in and out of the facility. These will include workers; visitors; customers and environmental inspectors among others. However, it is expected that traffic flow during the construction phase will be controlled and thus of no major concern.

Mitigation

a) Provide for adequate space at the entrance/exit along the access road to give drivers enough room to manoeuvre into and out of the project site;
b) Provide for adequate parking spaces at the site;
c) Provide road signage to alert road users of the presence of the facility and check for in-coming or out-going vehicles; and
d) Properly plan transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.

8.6.2. Increased demand on water resource-use

During the construction phase, both the workers and the construction works will create additional demand for water. Water will mostly be used by the workers in cleaning, in mixing of concrete for construction works and for wetting surfaces, curing or cleaning completed

structures. During operation, both workers and activities at the site will create additional demand for water. Water will mostly be used in general cleaning and in discharge of wastes. The increased water-use may be a source of possible sources of conflicts with other members of the community.

Mitigation

a) Consider the Water Act, 2002 and EMCA Act, 1999 which govern water abstraction and use and require permits for abstraction of large volumes of water for commercial use.

b) Ensure that installation of water supply system follows local government requirements.

c) Consider rain water harvesting to have alternative water supply

8.6.3. Increased demand on energy resource-use

During the construction period, electricity may be required to run machines such as soil compacting machines and drills. Fuel will be required to run generators, wheel loaders, excavators, and construction vehicles. On completion, the project shall consume large amount of electricity for lighting due to the electric appliances required. This will include laboratory machines, office equipment and outdoor lighting bulbs.. Since electric and fuel in Kenya are generated mainly through natural resources, namely water and geothermal resources, increased use of electricity have adverse impacts on these natural resource bases and their sustainability. The management intends to put florescent tubes and energy saving bulbs for lighting purposes. It is the government policy to minimize energy consumption.

Mitigation

a) Minimize energy consumption by:

- Using energy efficient night-time lighting only at the premises;
- Provide light sensor switches to ensure outdoor lights are not used during daytime;
- Switching off all energy using equipment when not in use; and
- Installing alternative energy sources such as solar panels and automatic generators not only for power back-up but also to reduce dependency on

electricity.

b) The management of the sewer plant should be advised to adopt more energy efficient measures to reduce on power consumption which would translate to cost saving and less burden on the insufficient power supply system in the county.

8.7. IMPACTS DURING THE DECOMMISSIONING PHASE

Demolition is the most critical part of decommissioning. If the project is demolished the likely impacts will include: dust, noise and vibrations, solid wastes and impacts associated with occupational health and safety among others.

8.7.1. Noise and vibrations

The demolition works may lead to significant deterioration of the environment within the project site and the surrounding areas through noise and vibrations. Noise is a health hazard while vibrations have the effect of lowering the strength of adjacent buildings by creating cracks in the walls.

8.7.2. Dust and exhaust emissions

Large quantities of dust will be generated during demolition works. Exhaust emissions will result from the machinery and equipment used in demolition. Dust and exhaust emissions are linked with health problems ranging from respiratory disorders to complex diseases of the respiratory system.

8.7.3. Solid wastes

Demolition of the sewer treatment ponds and related infrastructure will result in large quantities of solid wastes. The wastes will contain the materials used in construction including concrete, metals, drywall, wood, glass, paints, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since it is composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment. In addition, even the generally non-toxic chemicals such as chloride, sodium, sulphates and ammonia which may be released as a result of leaching of demolition waste are known to lead to degradation of ground water quality.

Mitigation to decommissioning phase impacts;

- The proponent should prepare and submit to NEMA a decommissioning report three months before decommissioning takes place.

- The use of the site or the building may be changed to other appropriate uses after renovation, rehabilitation and some structural changes have taken place. These uses may include change into a go-down, a restaurant or shops.
- The decommissioning and alternative land-use options will be facilitated by appropriate professional personnel incorporating environmental experts; county government planners; public works officers and public health officers among others.
- Since decommissioning may take long to be realized (say 50-100 years), the process shall follow the laws and regulation that will be in existence by that time.

8.8. NATURE OF NEGATIVE IMPACTS

8.8.1. CUMULATIVE IMPACTS

a. Short term negative impacts

- Water contaminations from effluents from construction machinery , contamination include oil leaks and fuel leaks
- Influx of heavy trucks and machinery in the area could cause nuisance, noise, dust and destruction of roads
- Loss of vegetation through stripping of top vegetation
- Soil erosion and destabilization of soil structure
- Atmospheric pollution by dust particles
- Increased noise and vibrations
- Influx of people in the area

b. Long Term Impacts

- Possibility of continual river contamination by unsatisfactory treated effluents from the WWTW
- The proposed technology will involve construction of oxidation ponds, and then chances of Hippos and crocodiles from Ol Kalou River are likely to infest the ponds and could cause a health risk to the people living round the plant and workers. The final design that has been approved for the project is for 1000 m^3/day waste water stabilization ponds, it therefore mean the works contract will have to include a comprehensible Bill of Quantity on fencing the

facility and more important is to ensure that the facility operates optimally so as to avoid eutrophication of the receiving Ol Kalou River which attracts wildlife.

- Possibilities of foul smell from the WWTW is inevitable if improper technologies are adopted, for example tapping of Methane gas from BOD, odour could be a nuisance to the community living around the WWTW and operators running the facility
- Possibilities of habitation of the area by Marabou stock, cattle egret and Hadada ibis species of birds common in the tropics of Africa causing danger to flights in the area.
- Possibility of river contamination by overflowing manholes blocked sewer trunks during operation phase, history of sewer puncturing to irrigate
- Possibility of underground contamination of ground water resources (aquifers) within the proposed site for WWTW
- Use of raw sewage to irrigate farmland along river basin where the trunks will be constructed, this will be experienced in Ol Kalou River especially during dry seasons, and this poses a major health risk to downstream ecology and persons consuming vegetables irrigated by raw sewage.
- Possibility of mosquitoes breeding in the ponds and pools of waste water in the WWTW could be a health hazard to the persons living around the proposed site and operators in the plant.

Mitigation for Short-Term Impacts

a) Water contaminations from effluents from construction machinery, contamination include oil leaks and fuel leaks

Mitigation

Proper servicing of machineries on site according to manufactures details, proper liquid waste collection system should be provided on site, stabilizing ponds could be constructed to hold waste water before releasing into the river

b) Influx of heavy trucks and machinery in the area could cause nuisance, noise, dust and destruction of roads

Mitigation

It is important to Grade of all access roads leading to proposed site using murram. Ensure regular wetting of the road to avoid dust nuisance. All trunks should undergo proper maintenance and servicing of the all trunks to ensure efficient performance.

c) Loss of vegetation through stripping of top vegetation

Mitigation

Minimizing vegetation stripping to sites where civil works are to be conducted, re-vegetation of site after civil works with complete reinstatement of the site to better status

d) Soil erosion and destabilization of soil structure

Mitigation

Thorough vegetation of the sites after completion of the civil works, proper berming of loss areas with gabions and mesh to limit the quantity of top soil lost by runoff

e) Atmospheric pollution by dust particles due to construction activities in the area

Mitigation

Regular wetting of the working area to control dust, provision of PPE to workers to avoid exposing them to gaseous pollutants

f) Risks of exposure to occupational Health and Safety issues.

Mitigation

Enlighten staff on the requirement of OSHA 2007 through arranging regular training sessions; provision of PPE to staff including fire fighting equipment on site.

The contractor should appoint an Environment Liaison Person to work closely with an Environment Compliance Officer from the client side to ensure mitigation measures proposed in the report are strictly compliant to, regular Environmental Audit will also be required on a twice per year to ensure the mitigation measures proposed the Environment Management Plan are being followed.

i. Mitigation for Long-term Impacts

a. Possibility of continual river contamination by unsatisfactory treated effluents from the WWTW

Mitigation

Regular inspection of the system to ensure performance is maintained at high levels; Blockages should be detected and promptly replaced; regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies

b. The risk of the ponds being inhabited by hippos and crocodile is inevitable.

Mitigation

Ensure that the plant operates optimally, and no eutrophication of Ol' Kalou River downstream by partially treated waste water, nutrients saturation in the river downstream will attract the wild animals.

The Plant if not properly fenced could attract wildlife like hyenas, wild dogs and rodents such as squirrels, crocodiles and Hippos; Proper fencing of the Plant to keep off wildlife is recommended;

Maintaining high standards of hygiene at the site throughout the operation phase of the facility; Constant consultations with KWS in event that wildlife is spotted in the area

c. Possibilities of foul smell from the WWTW is inevitable if improper technologies are adopted, for example tapping of Methane gas from BOD and Hydrogen Sulphide , odour could be a nuisance to the community living around the WWTW and operators running the facility

Mitigation

Tapping 100% of methane gas generated from the facility to generate electric, this will be tapped by covering the un-aerobic ponds with a polythelyne materials to tap the gases which will be eventually be purified and used to run electricity generators, hydrogen Sulphide HS_2 responsible for the foul smell will also be tapped.

The assessment proposes installation of windblown mixers or under water aerators in the facultative to increase oxygen circulation in the ponds

d. ***Possibilities of inhabitation of the area by Marabou stock, cattle egret and Hadada ibis. The birds could be a nuisance both to the community and charter planes flying in the area***.

Mitigation

Maintain high standards of hygiene within the WWTW, experience from DESTW indicate that birds are concentrated at the inlet works due to the solid wastes screened from the raw sewerage flowing to the treatment works.

The solid wastes should be promptly removed from site and disposed appropriately in a designated landfill

e. Possibility of river contamination by overflowing manholes blocked sewer trunks during operation phase, history of sewer puncturing to irrigate

Mitigation

Regular inspection of the system to ensure performance is maintained at high levels; Blockages should be detected and promptly replaced; regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies

Communities living within the river basins where the trunk sewers will be constructed should be enlightened on dangers of using raw sewerage to irrigate farmlands.

Training secession should be organized by NEMA and Rift Valley Water Services Board (RVWSB) through the supervising firm assigned to the project, the cost of the training should be included in the bidding documents under environmental restoration item to be included in the Preliminary and General.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section is intended to provide a concise structure of actions with specific priority level of action for the management of the environment during the construction, operation and decommissioning of the proposed project. Environmental and social management is best achieved by preparation and implementation of an Environmental Social Management and Monitoring Plan (ESMP) which ensures that environmental impacts are identified and mitigated during all phases of the project. The ESMP presented below has been proposed for this project and outlines corresponding management strategies that will be employed to mitigate potential adverse environmental impacts and assigns responsibility for the implementation of the mitigation measures. All costs are estimates and may change in time and space. As project commencement and scheduling plans are developed and changed, components of the ESMP might require amending. The ESMP is generally prepared to ensure that the components of proposed project are operated in accordance with the design.

9.1. PROPOSED DEVELOPMENT WITHOUT AN ESMP

This scenario is based upon the assumption that the proposed development would go on without any environmental management options being provided. The total project impact for the scenario is on the appreciably adverse side. This will show that if the project goes ahead without ESMP, the adverse impacts on the existing environment would be major.

9.2. PROPOSED DEVELOPMENT WITH AN ESMP

If the environmental management strategies discussed in the ESMPs are fully implemented, the adverse impact of the project would be reduced, and there will be an overall improvement in physical, chemical, biological and socio-economic environment of the region.

9.3. ENVIRONMENTAL MONITORING AND AUDITS

Environmental monitoring and audits are conducted to establish if project implementation has complied with established environmental management standards. Environmental monitoring and audits will be conducted to ensure that identified potential negative impacts are mitigated. EAs

will be conducted annually and will be based on the ESMP. EA reports will be submitted to the Authority –National Environment Management Authority.

The responsibility of Environmental Socio-Economic Management Plan (ESMP) for the proposed project is to initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. The ESMP identifies certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring.

The objectives of the ESMP will:

- Provide evidence of practical and achievable plans for the management of the proposed project.
- Provide the Proponent and the relevant Lead Agencies with a framework to confirm compliance with relevant laws and regulations.
- Provide community with evidence of the management of the project in an environmentally acceptable manner.

Finally, Environmental monitoring will provide feedback about the actual environmental impacts of a project. Monitoring results will help to judge the success of mitigation measures in protecting the environment. They will also be used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes. By tracking the project's actual impacts, monitoring will reduce the environmental risks associated with the project, and allow for project modifications to be made where required.

9.4. CONSTRUCTION PHASE ESMP

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
High Demand of Raw material	**1.** Source building materials from local suppliers who use environmentally friendly processes in their operations.	Proponent & Contractor	Throughout construction period	0
	2. Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered.			0
	3. Ensure that damage or loss of materials at the sewer construction site is kept minimal through proper storage.			0
	4. Use at least 5%-10% recycled, refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills			0
Soil erosion	1. To the greatest extent possible, plan to do the construction work during the short rains to minimize the exposure of loose soil to surface runoff.	The project engineer, RVWSB and contractor	During civil works	1,000,000
	2. As much as it's practically possible, phase site clearance so as to minimize the area of exposed soil at any given time	The project engineer, RVWSB and contractor		
	3. Back fill and compact excavated areas as soon as the laying of trunks is done			
Soil compaction	1. Strictly control construction vehicles to ensure that they operate judiciously and over designated areas to reduce soil compaction.	Contractor, site engineer and RVWSB	Throughout construction period	0
	2. Rip off any compacted areas after construction to allow aeration of soil and ease infiltration of water into the soil			500,000
Excavation	1. Properly demarcate the project area to be affected by the construction works to avoid spill over effects to neighbouring areas.	Site Engineer and RVWS B	Throughout construction period	0
	2. Carry out all excavation works as instructed in the approved architectural plans for the sewer plant and trunk			
Removal and disturbance of flora	1. Properly demarcating the project area to be affected by the construction works.		Throughout construction period	0
	2. Strictly controlling construction vehicles to ensure that they operate judiciously and over designated areas to minimize destruction of vegetation.	Contractor		0

	3. Re-establishing vegetation in some parts of the disturbed areas through implementation of a well-designed landscaping programme by planting of ornamental trees, flowers and hedges.	RVWSB	After project completion	2,000,000
Nuisance Dusting	1. To the greatest extent possible, plan to do the construction work during the short rains to minimize the generation of dust.	RVWSB and contractor	Throughout construction period	0
	2. During dry and windy conditions, access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust	Contractor		250,000 per month
	3. Workers on the site should be issued with dust masks during dry and windy conditions.		During dusty and windy period	2,000 per employee
Noise and vibrations	1. Sensitization of truck drivers to switch off vehicle engines while offloading materials;		Throughout construction period	0
	2. Instructing truck drivers to avoid running of vehicle engines or hooting especially when passing through noise sensitive areas such as religious areas, hospitals and schools;			0
	3. Properly servicing and maintaining and tuning construction machinery such as generators and other heavy duty equipment to reduce noise generation; and			700,000
	4. Placing noisy equipment in sound proof rooms or in enclosures to minimize ambient noise levels.		While carrying out noisy activities	200,000
	5. Planning the construction work to take place only during the day when the neighbours are also at work.		Throughout construction period	0
	6. Maintaining reasonable working hours so as to reduce the number of complaints concerning noise from the workers and neighbours.			0
	7. Operating shorter shift periods for workers who come in direct contact with high concentrations of noise or other hazards.			0
	8. Posting notices at the construction site informing the public of the construction activities, time and day.			100,000/once off
	9. Providing ear protective devices to prevent high frequency noise emitted by the high frequency machines during construction phase.	Contractor and RVWSB	While working in noisy areas	2000/person

Construction wastes and pollution	1. Covering all trucks hauling soil, sand and other loose materials and/or require these trucks to maintain at least two feet of freeboard;	Contractor and materials suppliers	Throughout construction period	10,000/per month/truck
	2. Watering all dust-active construction areas to suppress dust emissions; and	Contractor		10,000/activity
	3. Paving or applying water when necessary or applying non-toxic soil stabilizers on all unpaved access roads and parking areas.			200,000/month
	4. Advice drivers at the site to minimize vehicle idling time;			0
	5. Properly tune all equipment and maintain them in good working conditions; and			2,000,000
	6. Properly plan the transportation of materials and ensure that vehicle fills are increased so as to reduce the number of trips done and the numbers of vehicles on the roads.			0
	7. Handle chemicals and other potential pollutants carefully and appropriately.	Contractor and site workers		0
	8. Have a fully equipped first aid kit at the site at all times and ensure that trained first aid personnel are available to handle any incidents due to pollution at site.	Contractor	Once off	10,000/kit
	9. Provide all construction workers with personal protective equipment (PPE) including masks, goggles, scarfs, boots and overalls among other protective clothing as spelt out under section 101 (1) of OSHA 2007.		Throughout construction period	10,000/person for all PPE
Security	1. Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises.	RVWSB	Continuous	30,000/month
	2. Construction of a perimeter wall around the project area	Contractor	On commencement	5,000,000
Health and safety impacts	1. Implement all necessary measures to ensure health and safety of workers and the general public during operation of the housing project as stipulated in OSHA, 2007	Proponent	Continuous	-
First Aid	1. Well stocked first aid box which is easily available and accessible should be provided within the premises	Contractor	Throughout construction period	10,000/kit
	2. Provision must be made for persons to be trained in first aid, with a certificate issued by a recognised body.		One-off	10,000/person

Fire protection	1. Fire fighting equipment such as fire extinguishers should be provided at strategic locations such as stores and construction areas.	Contactor RVWSB & Contractor	One-off	20,000
	2. Regular inspection and servicing of the equipment must be undertaken by a reputable service provider and records of such inspections maintained		Every 3 months	10,000
	3. Fire escape routes and assembly point to be marked		Once	5, 000
	4. Signs such as "NO SMOKING" must be prominently displayed within the premises, especially in parts where inflammable materials are stored		One-off	5,000

9.5. OPERATION PHASE ESMP

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Contamination of Water Resources	1. The treatment pond should be made as impermeable as practically possible in order to prevent possible contamination of ground water or shallow wells in the area. The sewer line will be regularly inspected and maintained in order to safeguard against sewer line blockages and bursts.	OLWASCO & RVWSB	Throughout operation period	500,000/month
	2. Establish water quality monitoring lab			7,000,000
	3. Monitor the quality of effluent will be on a daily basis. Effluent quality analysis reports will be submitted to NEMA on a quarterly basis. Proper operation of the entire sewerage treatment system will be ensured and monitored for deviations to guarantee that effluent from the treatment pond meets the required standards. The water quality of the receiving streams will be monitored to check on changes on its quality.			200,000/quarter
	4. To prevent flooding into the ponds, a properly made embankment should be constructed around the ponds to prevent storm water mixing with sewer, since this may fill up the treatment ponds casing overflow			5,000,000
	5. The treatment pond should be made as impermeable as practically possible in order to prevent possible contamination			5,000,000

	of ground water or shallow wells in the area. The sewer line will be regularly inspected and maintained in order to safeguard against sewer line blockages and bursts.			
Odour	1. Ensure proper sizing and alignment of the lagoons	RVWSB	Throughout operation period	3,000,000
	2. Ensure scum is properly stabilized.	RVWSB, OLWASCO		
	3. Plant a strip of fast growing tree species around the ponds		Once off	
Flood Hazard	1. Designed surface water drainage structures around the waste stabilization pond site to prevent storm water inflow into the ponds.	RVWSB	During construction period	0

9.6. IMPACTS CROSS CUTTING DURING CONSTRUCTION AND OPERATIONAL PHASE ESMP

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Increased traffic flow	1. Provide for adequate space at the entrance/exit along the access road to give drivers enough room to manoeuvre into and out of the project site;	Contractor and RVWSB	Throughout construction and operation period	0
	2. Provide for adequate parking spaces at the site;			2,000,000
	3. Provide road signage to alert road users of the presence of the facility and check for in-coming or out-going vehicles; and			50,000
	4. Properly plan transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.			0
Increased demand on water resource-use	**1.** Consider the Water Act, 2002 and EMCA Act, 1999 which govern water abstraction and use and require permits for abstraction of large volumes of water for commercial use.	RVWSB, contractor,	Throughout construction and operation period	3,000,000
	2. Ensure that installation of water supply system follows local government requirements.	RVWSB, OLWASCO		
	3. Consider rain water harvesting to have alternative water supply		Throughout operation period	
	1. Using energy efficient night-time lighting only at the premises;	OLWASCO	During construction period	20,000

Increased demand on energy resource-use	2. Provide light sensor switches to ensure outdoor lights are not used during daytime;	OLWASCO, RVWSB	Throughout construction and operation period	40,000
	3. Switching off all energy using equipment when not in use; and	OLWASCO		0
	4. Installing alternative energy sources such as solar panels and automatic generators not only for power back-up but also to reduce dependency on electricity.	RVWSB		2,000,000
	5. The management of the sewer plant should be advised to adopt more energy efficient measures to reduce on power consumption which would translate to cost saving and less burden on the insufficient power supply system in the county	OLWASCO	Throughout operation period	0

9.7. DECOMMISSIONING PHASE ESMP

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Noise and vibrations, Dust and exhaust emissions Solid wastes	1. The proponent should prepare and submit to NEMA a decommissioning report three months before decommissioning takes place.	RVWSB	During decommissioning	1,000,000
	2. The use of the site or the building may be changed to other appropriate uses after renovation, rehabilitation and some structural changes have taken place. These uses may include change into a go-down, a restaurant or shops.			500,000
	3. The decommissioning and alternative land-use options will be facilitated by appropriate professional personnel incorporating environmental experts; county government planners; public works officers and public health officers among others.			500,000

10.INSTITUTIONAL CAPACITY AND TRAINING NEEDS

To ensure the proper functioning, and the efficient delivery of services, the abilities and skills of the all institutions required to implement the ESMP need to be built to overcome the implementation challenge at different levels by providing training on techniques, on the ground approaches, enhancing their technical operations, practical procedures and institutional facilities critical to the water services and sanitation. It is therefore critical that skills and systems in existence are evaluated and further propose optimum capacity processes for successful implementation of the project. Specifically it is important to;

i) Asses and report on the overall institutional capacity in the implementation of the proposed mitigation plan
ii) Determine the technical operations and management capacity needs of the institutions to improve the quality and reliability of services upon the completion of the sewerage project

In order to incorporate all the ESMP measures indicated in this study, responsible institutions are expected to acquire the institutional and technical capabilities. There is need to have cooperation among the responsible institutions to allow proper implementation, smooth follow up of the ESMP issues and know-how transfer. The institutions relevant to ESMP implementation and their current capacities in term of staffs, skills, tools and equipment and infrastructure are described hereunder required capacities for the same have also been proposed;

Table 19: Institutional Capacity Assessment

Impact	Proposed Mitigation	Responsibility	Status of Skills and Staffs	Status of Infrastructure	Status Of tools and equipment	Capacity Required
Water pollution	▪ The treatment pond should be made as impermeable in order to prevent possible contamination of ground water or shallow wells in the area. ▪ The sewer line will be regularly inspected and maintained in order to safeguard against sewer line blockages and bursts. ▪ Monitor the quality of effluent will be on a daily basis. ▪ Effluent quality analysis reports to be submitted to NEMA on a quarterly basis. ▪ The water quality of the receiving streams will be monitored to check on changes on its quality.	WRMA OLWASCO	▪ Lack of sufficient staffs in OLWASCO to manage the treatment plant ▪ Lack of skills by WRUAs to monitor quality of water being discharged into the reviews	• Availability of office space • Lack of office furniture	▪ Lack Water Quality Testing Lab and Field Equipment ▪ Lack of transportation means to facilitate water quality monitoring	▪ Employ and training for environmental auditors, plant operators and administrative staff ▪ Motor Vehicle and Motor-Bikes for monitoring ▪ Water quality laboratory and field monitoring stations ▪ Awareness Training for WRUAs ▪ Provide for additional office space and furniture
Oduor	▪ Ensure proper sizing and alignment of the lagoons ▪ Ensure scum is properly stabilized.	RVWSB OLWASCO	▪ Lack of sufficient internal design and supervision capacity	Not necessary	Not necessary	• Contract short-term design and supervision expertise • construct sludge stabilisation Sludge beds
Flood Hazard	▪ Designed surface water drainage structures around the waste stabilization pond	RVWSB OLWASCO	▪ limited in-internal design capacity ▪		~~None~~	Contract competent professionals to

	site to prevent storm water inflow into the ponds. ▪ flood proofing sewerage treatment works	County Government				design of construction works
Loss of natural habitat and biodiversity	▪ Clearing and construction activity should be restricted to within the footprint of the development. ▪ Excavated areas should be backfilled and planted with vegetation that is indigenous of the area ▪ River line vegetation indigenous of the area should be planted around the treatment ponds ▪ change in vegetation because of nutrient enrichment	RVWSB, WRMA KFS	▪ Mediums skills for natural habitat and biodiversity conservation ▪ Number of staff to enhance biodiversity conservation limited	▪ Low skills and facilities for monitoring changes	Not Necessary	Dedicated environmental desk officer Monitoring lab
Soil Erosion	▪ To the greatest extent possible, plan to do the construction work during the short rains to minimize the exposure of loose soil to surface runoff. ▪ Phase site clearance so as to minimize the area of exposed soil at any given time. ▪ Back fill and compact excavated areas as soon as the laying of trunks is done	Contractor OLWASCO	Not necessary	Not necessary	Not necessary	• Part of contractors bid
Nuisance dusting	▪ To the greatest extent possible, plan to do the	Contractor OLWASCO	• Induction training dust	None	None	• Part of contractors bid

	construction work during the short rains to minimize the generation of dust. ▪ During dry and windy conditions, access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust ▪ Workers on the site should be issued with dust masks during dry and windy conditions	RVWSB	management by contractors			
Noise	▪ Workers operating equipment that generates noise should be equipped with noise protection gear ▪ All noise generation works should be scheduled during day hours 8.00hrs to 17.00hrs	Contractor OLWASCO RVWSB	• Induction training on occupational health and safety tooling in basic skills	None	None	• Part of contractors bid
Solid waste disposal	• A site waste management plan should be prepared prior to commencement of construction works. • Proper solid waste receptacles and storage containers should be provided, particularly for the disposal of food remains and waste packaging materials • Reusable inorganic waste (e.g. excavated	Contractor OLWASCO RVWSB	• Limited staffs to manage solid waste • Limited skills in solid waste management	Not necessary	• Lack of garbage collecting trucks	• Training on solid waste management • Increase human capacity to manage solid waste • construct sludge drying bed as part of the project – but training operators, and equipment/technology to handle sludge

	sand) should be stockpiled away from drainage features and used for backfilling where necessary. • Unusable construction waste, such as damaged pipes, formwork and other construction material, should be sold to waste recyclers or be disposed of at an approved dumpsite. • wastewaters sludge					

ITEMS	AMOUNT
Plumbing and Field Equipment	4,500,000.00
Office Furnishing	3,000,000.00
Office and IT Support	5,000,000.00
Water Quality Testing Lab and Field Equipment	7,000,000.00
Replacement Equipment	1,100,000.00
Motor Vehicle and Moto-Bikes	8,400,000.00
Trainings and capacity development activities	2,000,000.00
SUB TOTAL	**31,000,000.00**

10.1. CAPACITY COST

In conclusion, it is necessary to form a Project Management Unit (PMU) "as part of RVWSB" has overall responsibility to monitor and follow up the project implementation activities. PMU role includes; identify priorities, establishing criteria for projects selection, approve projects, participate in bids evaluation, review technical and financial reports as well as daily monitoring, site visits and supervising of projects implementation. The PMU should also be responsible for taking the responsibility of monitoring the implementation of the monitoring plan and mitigation measures as well as enforcing the environmental regulations. The PMU should;

a) Conduct environmental review of the proposed packages and monitoring the implementation of the project.
b) Conduct site visits to review progress of and abidance with environmental measures.

c) Coordinate environmental training activities for staff, engineers and contractors.

11.ENVIRONMENT, HEALTH AND SAFETY (EHS)

The EHS is a broader and holistic aspect of protecting the worker, the workplace, the tools / equipment and the biotic environment. It is an essential tool in determining the ESIA project. The objective of the EHS on the proposed project is to develop rules that will regulate

environmentally instigated diseases and occupational safety measures during construction and the operation phases of the proposed project by:

- Avoidance of injuries.
- Provision of safe and healthy working environment for workers comfort so as to enhance maximum output.
- Control of losses and damages to plants, machines, equipment and other products.
- Enhance environmental sustainability through developing sound conservation measures.

11.1. THE GUIDING PRINCIPLES TO BE ADOPTED BY THE CONTRACTOR

The company will be guided by the following principle: -

- It will be a conscious organization committed to the promotion and maintenance of high standards of health and safety for its employees, the neighbouring population and the public at large.
- Ensuring that EHS activities are implemented to protect the environment and prevent pollution.
- Management shall demonstrate commitment and exercise constant vigilance in order to provide employees, neighbours of the project and the environment, with the greatest safeguards relating to EHS.
- Employees will be expected to take personal responsibility for their safety, safety of colleagues and of the general public as it relates to the EHS management plan.

11.2. EHS MANAGEMENT STRATEGY TO BE ADOPTED BY THE CONTRACTOR

The following strategies will be adopted to achieve the above objectives:

- Create an Environment Health and Safety Management committee and incorporate EHS as an effective structure at various levels and units to manage and oversee EHS programs in all construction and operation phases of the project
- Maintain an effective reporting procedure for all accidents.
- Provide appropriate tools and protective devices for the success of the project.

- Encourage, motivate, reward and support employees to take personal initiatives and commitment on EHS.

11.3. SAFETY REQUIREMENT AT THE PROJECT SITE

The following safety requirements are both for Construction and Operation Period

(a) The Contractor

The contractor will ensure that:

- Safe means of entry and exit exist at the proposed project site.
- Ensure adequate briefing of job at hand on the safe system of work before commencement of work
- The EHS coordinator must be in attendance at all times throughout the duration of the project.
- The EHS consultant must maintain constant assessment of the risk involved as the work progresses
- A safety harness must be worn before entry into all confined spaces
- An EHS consultant must be posted at the entrance of the project site to monitor progress and safety of the persons working at the construction site.

(b) The Traffic / Drivers

Within the construction premises, the following traffic rules will be observed: -

- Observe speed limits and all other signs and obey traffic rules.
- Use the vehicle for the purpose to which it is intended only.

c) Fire Hazard at the Construction Site

The proponent shall provide:

- Adequate numbers of 9litrres Co_2/water fire extinguishers at strategic points
- Emergency light within the premise
- Automatic alarm to cover the project
- Electric fire alarms system with secondary power supply from stand by generator

- Adequate 9kg. dry powder fire extinguishers
- Fire instructions and fire exit signs
- Mark a fire assembly point
- Ensure adequate number of staffs are trained on fire-fighting techniques
- Form fire fighting committee and appoint fire Marshalls

11.4. WELDING AT THE CONSTRUCTION SITE

It is the responsibility of the contractor during construction to: -

- Ensure that welding clamp is fixed such that no current passes through any moving parts of any machine.
- Ensure that all welding clamps are in good operating condition and conduct current without arcing at the point of contact.
- Ensure that welding clamps are free from any contact with explosive vapours i.e. Oil spillage, Fuel tanks, Coal dusts and miscellaneous combustible material (e.g. Cotton rags, filter bags, rubber belting, and wood shavings).
- Ensure that any slag or molten metal arising from welding activities does not start up fires by:
    - Clearing combustible material to a distance of at least 3 meters away from the working area or covering area with metal or asbestos sheet.
    - Appropriate fire extinguisher is to be kept available for immediate use at all times

11.5. EMERGENCY PROCEDURES DURING CONSTRUCTION AND OPERATION

In the event of an emergency during construction, the workers shall:

- Alert other persons exposed to danger.
- Inform the EHS coordinator.
- Do a quick assessment on the nature of emergency.
- Call for ambulance on standby.

- When emergency is over the EHS coordinator shall notify the workers by putting a message: "ALL CLEAR"
- Provision of emergency power (Generator)

In the event of such an emergency during operation the workers shall: -

- ✓ Alert other persons exposed to danger.
- ✓ Ring the nearest police station
- ✓ Call for ambulance on standby.

12. ESIA RECOMMENDATION AND CONCLUSIONS

12.1. RECOMMENDATIONS

In the previous section mitigation measures for the identified issues mentioned above has been detailed. Ensuring proper mitigation measures are instituted will be the responsibility of RVWSB. RVWSB will need to ensure the following:

- Appropriate corporate policies and guidelines on environment necessary for smooth running of the Sewer treatment plant and associated facilities are in place.
- Capacity building for project component management
- Effluent Monitoring by construction of a well-equipped simple water laboratory facility within the site for effective and efficient effluent analysis

- The staffs are equipped with the necessary facilities and skills for effective management of their safety, health and protection of the environment.
- Occupational, Health and Safety gadgets such as firefighting equipment, PPE, disaster management training, first aid training among others;
- That the entire project implementation will not cause any unnecessary disruption to public utilities, storm water/surface runoff drainage systems, ecological systems and human settlement. Whenever any of these problems or any other impact highlighted in this report are anticipated, then the management will take appropriate mitigation actions.
- Fence out the sewer treatment plant to prevent unauthorized entry of domestic animal, wildlife and human beings
- Ensure embankments around the ponds are properly done to prevent storm water mixing with the sewer
- Plant fast growing trees species known for good land rehabilitation capacity and no alellopathic effect round the perimeter of site to reduce or contain the odour. The best tree species include; *casuarina equsitifolia* and *graveria robusta*.
- Constant monitoring of olkalou river water quality should be done to note any pollution detection and appropriate measures taken to correct the same.
- A proper resettlement action plan should be carried out to identify affected individuals and compensation done according to Kenyan laws and AfDB resettlement policies. This will prevent conflicts that may arise during project implementation
- RVWSB shall ensure that all natural resources including water, flora and fauna are protected and conserved during design, construction and operation

Further the following recommendations are made with respect to the contractor's responsibility;

- The Contractor shall ensure that construction of all facilities in the proposed Project is carried out in accordance with the designs;
- The Contractors and the Proponent shall ensure that the stakeholders' views are fully exhausted and that any unforeseen impacts shall be immediately addressed and mitigated;
- The Contractor shall ensure that the proposed mitigation are put in place to ensure that noise, vibrations and dust are managed to acceptable levels;

- The Contractor shall put in place measures to manage waste emanating from project construction activities;
- Land contamination and erosion shall be mitigated accordingly and measures shall be put in place by the Contractor to prevent the occurrence of such incidences;
- The Contractor will implement measures as proposed in this report and others in the field to ensure that fire incidents are prevented, minimized or managed;

Monitoring should include the following aspects

- Maintain appropriate monitoring points within the sewer plant
- Identify the most critical parameters to monitor including among others the BOD, COD, TSS, waste treatment efficiency of the facility, energy consumption trend and changes in social perception.
- Carry out annual environmental audit to ensure continued compliance with environmental regulations under the national laws.

12.2. CONCLUSION

During the preparation of this report, it is observed and established that most of the negative impacts on the environment are rated low and short term with no significant effect. The positive impacts are highly rated and will benefit all stakeholders at large. These positive impacts include; elimination of discharges of untreated sewage to the Ol Kalou River, provide wastewater management infrastructure for Ol-Kalou Town, lead to environmental conservation and management as pollution from septic tank leakages will be eliminated, provision of employment opportunities during both construction and operation phases, centralization of town's wastewater treatment making pollution monitoring easy and more effective, improvement of health among others.

RVWSB has proposed to adhere to prudent implementation of the Environmental Management Plan. RVWSB has proposed adequate safety and health mitigation measures as part of the

relevant statutory requirements. It is therefore concluded that the proposed project will not compromise the wellbeing of the neighbours, area ecological and environmental conditions and will improve economic wellbeing of resident of Ol Kalou Town. It is therefore recommended that the proposed project be approved subject to the following recommendations:-

- RVWSB should make all the necessary efforts to comply with conditions set in the various approvals and licenses issued by various authorities including Ministry of Lands, Physical Planning, Health Department, Nyandarua County Government and National Construction Authority
- Ensure implementation of the proposed mitigation measures and compliance with the ESMP during the project cycle.

13.REFERENCES

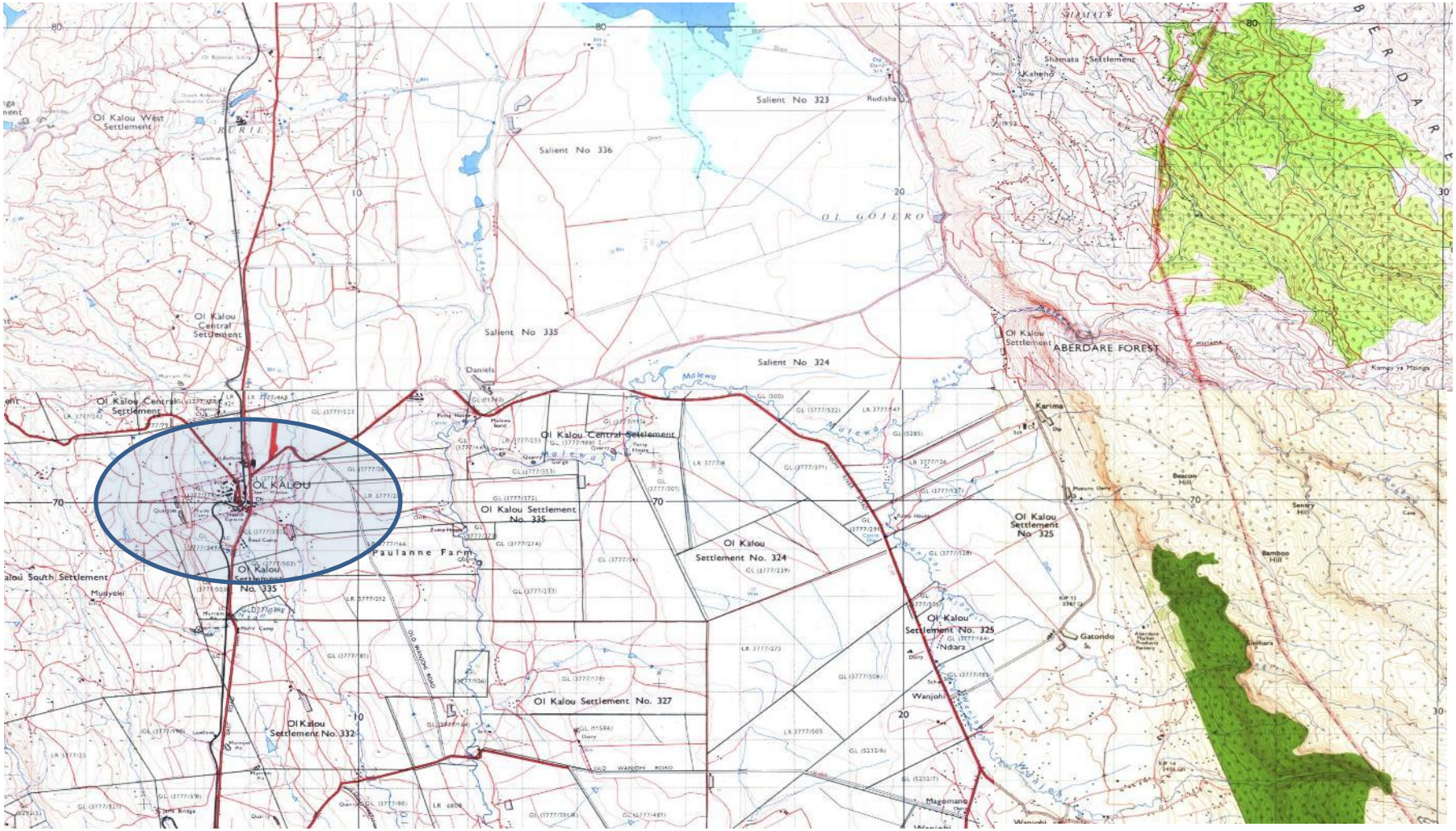
1. Environmental Management and Coordination (Conservation of Biological Diversity) Regulations, 2006. Government Printer, Nairobi.
2. Environmental Management and Coordination Act 1999 and Environmental Impact Assessment and Audit Regulations Regulation 2003
3. GoK, Vision 2030
4. Housing and Population census report 2009, Ministry of Planning and National Development
5. Kenya Gazette Supplement Acts Water Act, 2002. Government Printer, Nairobi.
6. Kenya Gazette Supplement Number 69. Environmental Management and Coordination

(Waste Management) Regulations, 2006. Government Printer, Nairobi.

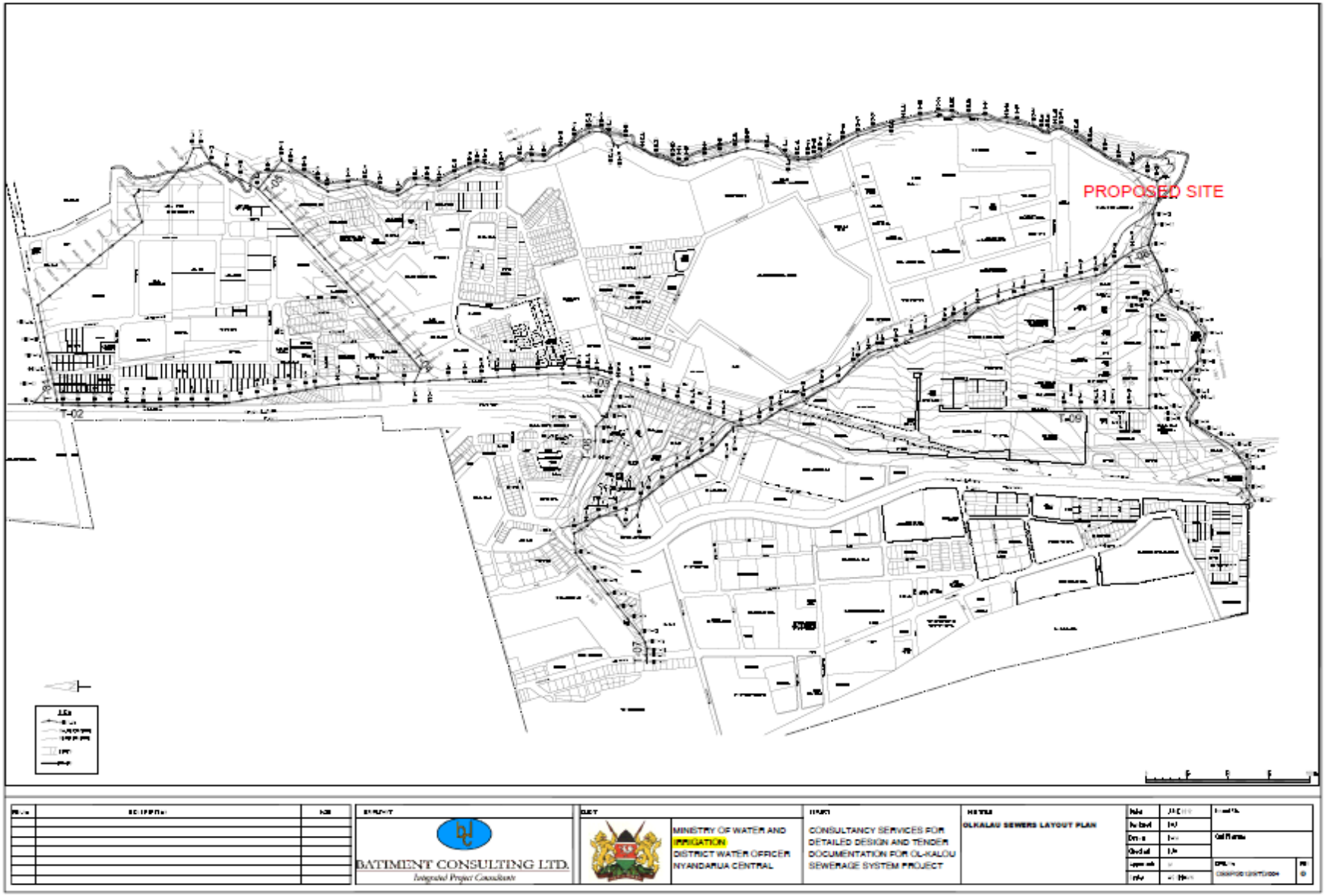
7. National Environmental Action Plan Framework 2009 –2013. Occupational Safety and Health Act, 2007.
8. Nyandarua county integrated development plan 2013-2017
9. Republic of Kenya, 2006. Water Quality management regulations, 2006. Kenya Gazette
10. Water Resources Management Rules, 2007.

14.ANNEXES

14.1. ANNEXES 1: PROJECT AREA



14.2. ANNEXES 2: PROJECT NETWORK LAYOUT



14.3. ANNEX 3: MINUTES DURING PUBLIC AND STAKEHOLDERS MEETING

OL KALAO TOWN SEWERAGE PROJECT STAKEHOLDER & PUBLIC CONSULTATION MEETINGS HELD ON 04 AND 5TH /08/2016

AGENDA:

01. Introduction
02. Key Note address
03. Project and project components
04. Public Consultation
05. A.O.B

1. Introduction

The meeting was called primarily to discuss on the proposed Ol Kalou Sewerage Project by Rift Valley Water Services Board. The meeting was aimed at capturing stakeholders view on the projects impacts in preparation of an Environmental Social Impact assessment report before the commencement of the project.

The report will discuss measures that will ensure that all the environmental concerns are integrated in the project cycle namely planning, implementation and operation phases in order to contribute to sustainable development of the general project area and areas in close proximity to it

2. *Min 01/16: Key Note address*

The deputy director for environment and natural resources for Nyandarua County reckoned that environmental issues within the county are not given the required prominence. She maintained that environmental conservation and protection plays a key role in enhancing the quality of water.

The CEO WASREB maintained that the development of a sewer and treatment plant will be of public value to the people of Nyandarua County. He stressed that water and sanitation issues cannot be separated as one impact on the other if not well managed. He insisted that for project to become successful community should be allowed to solve their own problem and financial transparency should be paramount.

The deputy director for water in Nyandarua County maintained that lack of a sewerage component in Ol Kalou Town has contributed to the poor ranking of the Ol Kalou water and Sewerage Company in the WASREB performance review annual reports.

3. Min 02/16: Project and projects components

The project and the various project components were widely discussed and the following question arose during this period

- **Question 1:** The sewerage was design in 2012 when the town had not acquired a status of the county headquarters, how will it accommodate the anticipated influx of population and infrastructural growth?

  Answer: The Client (RVWSB) plans to review the design to accommodate the anticipated population and infrastructural growth in the town

- **Question 2:** The county government of Nyandarua is constructing an aerobic treatment plant in the proposed site, how do RVWSB plan to link the two projects together?

  Answer: The aerobic treatment plant being constructed by the county government will have a capacity of treating 22, 000 liters per day which is less compared to the current demand and therefore, the two systems will be interlinked to address the sanitation challenges within the town.

- **Question 3:** How will solid waste be managed within the proposed site?

  Answer: One of the recommendations that will be made in the Environmental and Social Impact Assessment report is to demarcate the proposed site both the liquid and solid waste site. The locals can also benefit from the by way of recycling and reusing of some of the solid waste and possibly develop fertilizers from the sludge.

- **Question 4:** what are the various measures that have been put in place to ensure project acceptance by the locals?

  Answer: There will be a public participation forum that will allow the public to give their views regarding the public. Local leaders such as chiefs and sub-chiefs have been in the forefront of sensitizing the community about the benefit of the proposed sewerage projects.

- **Question 5:** Who will be the custodians of the projects once it is completed and implemented?

  Answer: Ol Kalao Water and Sewerage Company will be mandated to manage the sewerage project after its completion

- **Question 6:** Storm water is a major concern within the town; will this issue be addressed during the construction of the project?

  Answer: The project will take note on possible flooding after the implementation of the project within the project site and possible mitigation measures will be outlined. Storm water within the town is connected to efficient drainage system and town planning which is possibly may not be address under this project

4. Min 03/16: Public consultation meetings

Two public consultation meeting took place on 5th August 2016. One meeting was held within the town area whereas the other one took place within the proposed project site.

The public consultation meetings were aimed at gathering the public views regarding the proposed town sewerage project. Public participation is a legal requirement before the commencement of any project so as to solicit public opinion regarding the project. This allows public ownership of the project before and after its completion.

The following are some of the questions that arose during the meeting;

- **Question 1:** Before discharging water to the nearby rivers, how will the quality of water be measured to ensure that the water being discharged to the rivers does not negatively impact people who are downstream?

  Answer: One of the components of the proposed project is a laboratory therefore; all water that will be discharged into the nearby stream will tested to ensure they comply with stipulated accepted levels in the WRMA Act.

- **Question 2:** How will the people who have genuine title deeds within the project site be compensated and also those individual who will have the sewer trunk passing through their premises?

  Answer: One of the components of the ESIA is to develop a resettlement action plan, which will identify the exact number of project affected persons and proposed a budget for their resettlement plan.

- **Question 3:** Is there possible duplication of project since the county government is currently constructing an aerobic treatment plan?

  Answer: No, the current construction is an aerobic treatment facility whose capacity is 22, 000 liters and does not satisfy the town waste water treatment demand within the town. The proposed project plus the on-going construction will be interlinked to meet the town demand.

- **Question 4:** How will the project benefit the local community? In the past we have had contractors bring their own people to do the construction whereas the town has youth who can do the same work

  Answer: It is expected that the project will offer employment to the locals among other positive impacts. In the ESIA report, it will be recommended that the Client (RVWSB) ensure the contractor employ the locals when the construction commence. Further, the client will ensure materials being used for construction be purchased within the town

- **Question 5:** The current state of the proposed site is pathetic, waste water is finding its way into the river, children and livestock are finding their way into the solid waste disposal site. What are the measures that will be put in place that will ensure that the area is not accessible to human being and livestock as this is having serious negative impacts to the two?

  Answer: The client is expected to demarcate the area and fence it to ensure no unauthorized human being and livestock is accessing the site.

- **Question 6:** How will odor be managed around the proposed site?

  Answer: It is recommended that trees to be planted around the proposed sewerage site to minimize odor

5. Min 03/16: A.O.B

i. The Residents of Nyandarua County to be given highest priority in the tendering process
ii. The sewerage project timelines should be set and communicated early to the locals

Having no other issues the meeting was adjourn.

14.4. ANNEXES 4: PUBLIC PARTICIPATION ATTENDANCE LIST

MAHINGA SITE

PP

PROPOSED CONSTRUCTION AND OPERATION OF A SEWER SYSTEM FOR OLKALOU TOWN-NYANDARUA COUNTY BY RIFT VALLEY WATER SERVICES BOARD

STAKEHOLDERS ATTENDANCE SHEET

No.	NAME	ID NO	MOBILE NUMBER	ORGANISATION	DATE	SIGNATURE
1	ESTHER NGANGA	24520731	0721122136	BEA	5/8/2016	[signature]
2.	Dan Amollo	28468765	0711560490	BEA	5/8/2016	[signature]
3.	KIBE PETER MWANGI	28795760	0715 030114	BEA	5/8/2016	[signature]
4	Eilan MUIGAI	23004836	0717207408	Expert	5/8/16.	[signature]
5	Charles Murage	5960788	0720496339	RVWSB	5/8/16	[signature]
6	Benson Gacara	32188876	0724037287	Other	5/8/16	[signature]
7	PETER MWANGI WAMBUGU	9812591	0724290661	WARD ADMIN - KAMBAGA	5/8/16	[signature]
8	JULIUS MAINA	02365810	0726315447	OLWASCO.	5/08/16	[signature]
9	John NGIGI	5768623	0722244727	NYANDARUA WATER	5/8/16	[signature]
10	Eng. JOSEPH KARANJA	10709529	0727865067	DEPT WATER E, NR	5/8/16	[signature]
11	Myriam -M. Ngotho	9256816	0729604951	DEPT. WEENR	5/8/16	[signature]
12	Gladys Mudave	9777111	0721926721	RVWSB - Sociologist	5/8/16	[signature]
13	Peter muriithi	27398248	0717407611	public. sounds	5/8/16	[signature]
14	Stephen Ngaruga	0713792	0710997784	Farmer	5/8/16	[signature]
15	Zacharia K. Gatimu	0726461721	5768314	farmer	5/8/16	[signature]
16	Stephen. K. Kuria	4907444	0727612028	farmer	5/8/16	[signature]
17	Mercy Njoroge	9237721	0720134972	Farmer	5/8/16	[signature]
18	Josphat Kariuki	1420398	0725361023	VILLAGE Elder	5/8/16	[signature]
19	Francis W. Wanjohi	7865588	0700236969	A-CHIEF	5/8/16	[signature]
20	Zablon G Gathau	2965049	0725599381	Farmer	5/8/16	[signature]
20	Betrice Wanjari	9810958	0713060825	farmer	5/8/16	[signature]
21	VIOLET MIDEVA	24881690	0725945812	farmer	5/8/16	[signature]
22	Joseph munyora kariuki	11341746	0727254271	farmer	5/8/16	[signature]
23	ALICE KIANGUI KURIA	32084242	0792338835	FARMER	5/8/16	[signature]

	NAME	ID	MOBILE	ORGANISATION	DATE	SIGN
24	VERONICA WANJIRA	27075533	0710631444	FARMER	5/8/2016	[illegible]
25	TABITHA MUTHONI CHRISTOPHER	22497258	0727814724	Farmer	5/8/2016	[illegible]
26	ESTHER WAMAITHA KAMAU	11828844	0712486609	FARMER	5/8/2016	[illegible]
27	LEAH WANJIRU MWANIKI	11178351	0720317802	FARMER	5/8/16	[illegible]
28	PAUL W. WANYOIKE	4863337	072531844[illegible]	FARMER	5/8/016	[illegible]
29	JANE WAMBUI		0714340657	FARMER	5/8/016	
30	STEPHEN MUCHENDU	9810538	0724732246	V/ELDER	5/8/016	[illegible]
31	Stanley [illegible]	0344135	0726226755	Resident	5/8/2016	[illegible]
32	Wilson [illegible]	13393030	0726414943	Farmer	5/8/2016	[illegible]
33	Elizabeth W. Mithamo	2931767	072613242[illegible]	Farmer	5/8/2016	[illegible]
34	MARGARET NYAKARURA	13645578	0706655664	FARMER	5/8/2016	[illegible]
35	AGNES KOECH	10506622	0722362119	RVWSB	5/8/2016	[illegible]
36	STEPHEN NJUGUNA KINGANJUI	2931299	0727042419	CHURCH	5/8/2016	[illegible]
37	Joseph Kinyua Kigor	9945003	0726087139	Resident	5/8/2016	[illegible]
38	SAMUEL MWANIKI	22372096	0727180409	RESidents	5/8/2016	
39	David Kamau	11428543	0728484653	Residents	5/8/2016	
40	Peter John Ndungu	4345179	0708539609	Farmer	5/8/2016	[illegible]
41	MARGARET MERI	23175197	0705913228	Farmer.	5/8/2016	[illegible]
42	GLADYS WANJIKU	5770713	0713620352	FARMER	5/8/2016	[illegible]
43	John Mwago	2956005	0724210368	FAMER.	5/8/2016	[illegible]

WATER SERVICES BOARD

BeAssociates

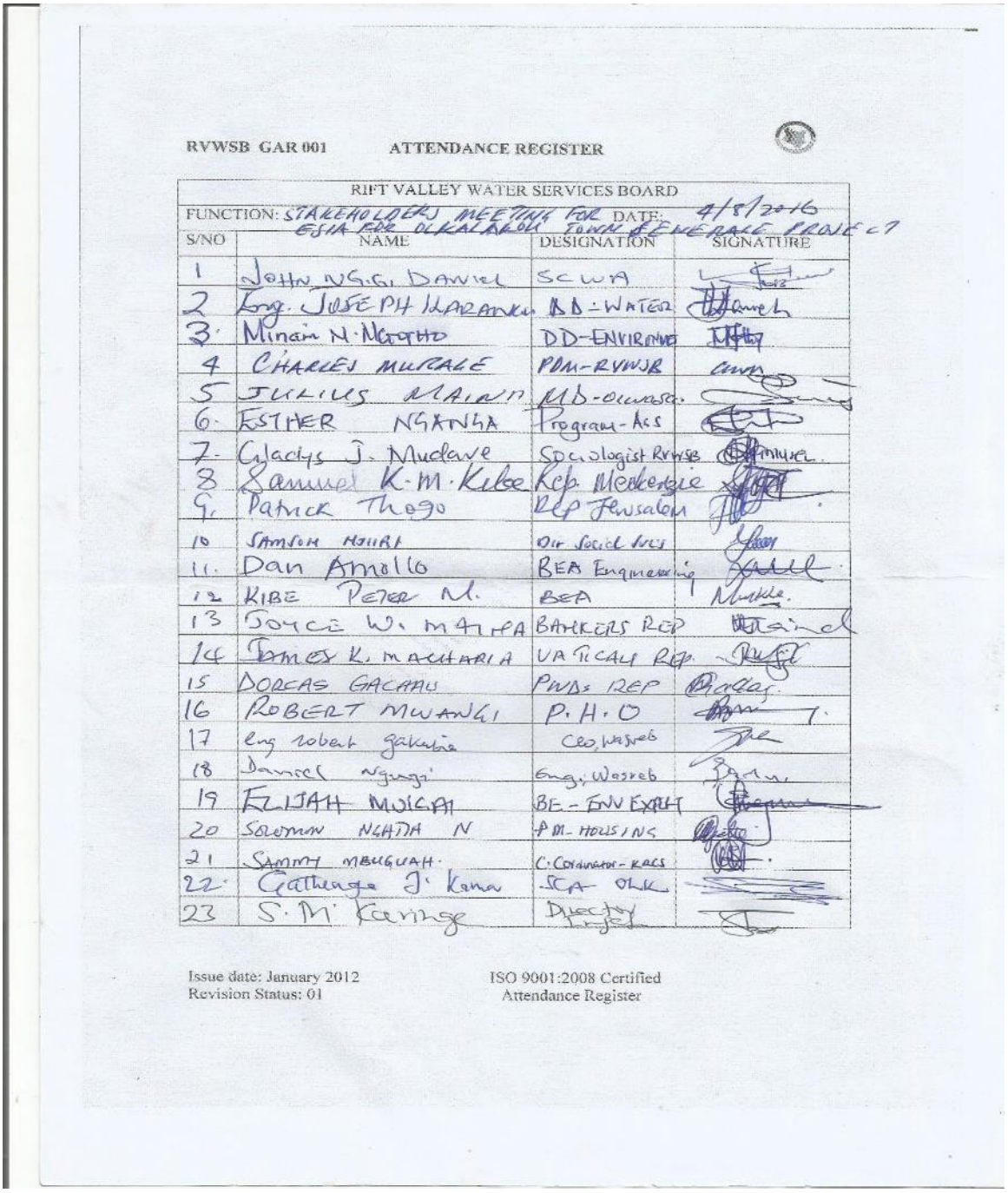
25	Eng. Joseph Karanja	10709529	0727 835067	DEPT WATER, E&NR	5/8/16	[signature]
26	Grace Njoroge	10183217	0728666535	Beusnes	5/8/16	[signature]
27	Ochuku B. Arita	9111767	0722-941097	Businessman	5/8/16	[signature]
28	Gladys Mudave	9777111	0721926721	RVWSB	5/8/16	[signature]
29	Charles Murage	5960788	0720496339	RVWSB	5/8/16	[signature]
30	John M Gichini	7261210	0727238822	Business	5/8/16	[signature]
31	Joseph Chege Mwangi	0454992	0725339659	WATER & NR	5/8/16	[signature]

PROPOSED CONSTRUCTION AND OPERATION OF A SEWER SYSTEM FOR OLKALOU TOWN-NYANDARUA COUNTY BY RIFT VALLEY WATER SERVICES BOARD

PUBLIC BARZA ATTENDANCE SHEET

No.	NAME	ID NO	MOBILE NUMBER	ORGANISATION	DATE	SIGNATURE
1	ELIJAH MUIGAI	23004834	0712204608	EXPERT	5/8/16	[signature]
2	ESTHER WAMBUI	24529731	0721122136	BEA	5/8/16	[signature]
3	PETER MWANGI KIBE	28795760	0715070114	BEA	5/8/16	[signature]
4	Dan Amollo	28468765	0715404490	HEMA REG EXPERT	5/8/16	[signature]
5	BENSON GACARA	3418806	0724237287	CHIEF	5/8/16	[signature]
6	JULIUS MAINA	0236581	0726305477	OLWASCO	5/08/16	[signature]
7	Daniel Mwangi W	23274040	0739209700	A.P.E.T.P.RECO FBO	5/08/16	[signature]
8	PETER MWANGI WAMBUGU	9812593	0724290661	WARD ADMIN-KAIMBAGA	5/8/16	[signature]
9	JOHN NGIGI DANIEL	5768623	0722244727	WATER	5/8/16	[signature]
10	Naomi Wambui Maina	13844374	0726103301	Business woman	5/8/16	[signature]
11	ROSE MARY MATHENGE	7071711	0724569662	Business lady	5th/Aug/2016	[signature]
12	Paul Kamau	12545373	0723706493	Businessman	5th/Aug/2016	[signature]
13	Stanley N. Ndirangu	0344135	0726226765	Businessman	5/8/2016	[signature]
14	Peter Kamau Njoroge	0340240	0721101606	KYU community	5/8/16	[signature]
15	SAMUEL K. MACHARIA	2930768	0723262466	VATICAN COM. Rep	5/8/16	[signature]
16	WILLIAM MUCHAIRIA	0681195	0728611213	BAHATI	5/8/2016	[signature]
17	CHARLES WANDELA	363372	0704053868	BUSINESSMAN	5/8/2016	[signature]
18	CHARLES MUNGAI	0805322	0722472349	FARMER	5/8/2016	[signature]
19	Pelo Gala	8550848	0711601473	EL AIR-VAS	5/8/2016	[signature]
20	Peter muiruri	27398266	0717407611	public address	5/8/2016	[signature]
21	Miriam M. Ngotho	9256816	0729604951	WEENR-DD ENV	5/8/2016	[signature]
22	HONEST KOVELI	10056622	0722362119	Vendor	5/8/2016	[signature]
23	Isaac Ndungu	7534950	0726881810	Driver	5/8/2016	[signature]
24	LYDIAH WAMUYU MAINA		0791649397	Business Lady	5/8/2016	[signature]

14.5. ANNEXES 5: STAKEHOLDERS ATTENDANCE LIST



RVWSB GAR 001 ATTENDANCE REGISTER

RIFT VALLEY WATER SERVICES BOARD

FUNCTION: STAKEHOLDERS MEETING FOR ESIA FOR OLKALAOU TOWN SEWERAGE PROJECT DATE: 4/8/2016

S/NO	NAME	DESIGNATION	SIGNATURE
1	JOHN NG'ANG'A DANIEL	SCWA	
2	Eng. JOSEPH MARANGA	AD - WATER	
3	Minam N. NGOTHO	DD-ENVIRONT	
4	CHARLES MURAGE	PDM-RVWSB	
5	JULIUS MAINA	MD-OLKALOU	
6	ESTHER NGATNGA	Program-Acs	
7	Gladys J. Mudave	Sociologist RVWSB	
8	Samuel K.M. Kibe	Rep. Mekenzie	
9	Patrick Thogo	Rep Jerusalem	
10	SAMSON MUIRI	Dir Social Inc	
11	Dan Amollo	BEA Engineering	
12	KIBE PETER M.	BEA	
13	JOYCE W. MATHA	BANKERS REP	
14	JAMES K. MACHARIA	VATICAL Rep.	
15	DORCAS GACHAU	PWDs REP	
16	ROBERT MWANGI	P.H.O	
17	eng robert gakuba	CEO, Wasreb	
18	Daniel Nyungi	Eng; Wasreb	
19	ELIJAH MUIGAI	BE - ENV EXPERT	
20	SOLOMON NGATIA N	A.M - HOUSING	
21	SAMMY MBUGUAH	C: Coordinator - KACS	
22	Gathenge J. Kama	SCA OLK	
23	S.M. Karinge	Director	

Issue date: January 2012
Revision Status: 01

ISO 9001:2008 Certified
Attendance Register

14.6. ANNEXES 6: PICTORIALS

Public Baraza- Ol Kalou Town Residents

Public Baraza- Locals within the proposed site

Stakeholders Meeting

Current Disposal site in the proposed sites

Exhauster services

Solid waste site

On-going construction of an aerobic treatment facility

14.7. ANNEXES 7: TERM OF REFERENCES

RIFT VALLEY WATER SERVICES BOARD

MULTI - TOWNS SUSTAINABLE WATER SUPPLY AND WASTEWATER MANAGEMENT PROGRAM

CONSULTING SERVICES
FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
FOR OLKALOU TOWN SEWERAGE PROJECT

TERMS OF REFERENCE

May 2016

1. Scope of the Study

Environmental and social impact assessment will include: -

1) The analysis of the socio-economic and socio-environmental status of the affected areas during pre and post construction and thus justify development of the water and sanitation project.

2) Assessment of the community's capacity to implement the proposed mitigation measures, and make appropriate recommendations, including potential capacity building and training needs and their costs.
3) Based on the environmental baseline survey, there will be the preparation of an Environmental and Social Management Plan (ESMP) that outlines:

a. Potential environmental and social impacts resulting from the activity;

b. Proposed mitigation measures;

c. Reviewing of Institutional arrangements, training requirement and responsibilities for monitoring implementation of the mitigation measures and monitoring indicators;

d. Proposed work program, budget estimates, schedules, staffing and other necessary support services to implement the mitigation measures;

e. Assesses compensation to affected parties for impacts that cannot be mitigated;

f. Assist the proposed concerned parties in their agreement on the time horizons and mitigation measures for implementing the recommendations in the ESMP;

g. Predict the impacts upon communities and individuals and prepare a Resettlement Framework and/or Resettlement Action Plan if land acquisition is found necessary;

h. Evaluate the social impacts and show how the Communities in the area will benefit or lose upon implementation of the project;

i. Based on the information collected from the Social Economic Baseline Survey, the Consultant will show how the identified adverse effects will be mitigated.

j. Consult with affected groups likely to be affected by the proposed project and with all stake holders on the environmental and social aspects of the proposed project;

k. Maintain a record of public consultation and other records that will indicate: surveys used to seek views of affected stakeholders; date and location of consultation meetings; a list of attendees, their affiliation, contact addresses and a summary.