REPUBLIC OF KENYA

TECHNICAL STUDIES, DESIGN AND SUPERVISION OF WORKS PACKAGE 1 AND 2 IN KISUMU CITY AND SATELLITE TOWNS UNDER LVWATSAN PROGRAM

Environmental and Social Impact Assessment Report for Works Package 2-Lot 2

Dunga Raw Water Intake and Water Treatment Plant

June 2021

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Project n°	A00224
Name of the document	Environmental and Social Impact Assessment Report for Works Package 2 Lot 2
Project owner	Lake Victoria South Water Works Development Agency

Creation date of the document	June 2021
Reference of the document	
Index	
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Date of issue	Index	Remarks	Produced by	Verified and validated by
June 2021		FINAL VERSION	BRLI/ISEP	L. GIRARD / C. OPATI

CERTIFICATION

Environmental and Social Impact Assessment- June 2021 Final Report

Prepared by

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EXECUTIVE SUMMARY

1.0 Introduction

In this section, we present general information that summarizes the findings of the Environmental and Social Impact Assessment (ESIA) for the proposed Dunga Raw Water intake and Water Treatment Plant. The objective of this study was to evaluate the environmental impacts that are likely to emanate from construction, operation and decommissioning phases of the proposed project. We have, as a way forward suggested ways of reducing the identified negative impacts and optimizing the likely benefits.

2.0 Proposed Project

The proposed works will involve the improvement of Dunga Raw Water intake works, transmissions system and Water Treatment Plant. The Works will consist of improvement of Dunga intake and pump station, construction of raw water rising main and rehabilitation of Dunga Water Treatment Plant. Works at the intake will involve installation of pumps and accessories, installation of KPLC power supply including transformer upgrading for lighting. At the Water Treatment Plant, a number of improvements will be carried out on the collection and distribution chambers, sedimentation tanks, filter units and treated water collection channels. Pipes connections and fittings within the treatment works units will also be harmonized and improved.

3.0 Objective of the Project

The principal objective of the project is to rehabilitate and improve structures and facilities at Dunga Raw Water Intake and Water Treatment Plant to make them effective in the water treatment process.

4.0 Scope of works

The proposed works will be carried out at the Raw Water Intake, Transmission Mains and Water Treatment Plant. At the Dunga Raw Water Intake, the works will include the decommission of 1958 and 1985 (Option 2) pump stations; increasing capacity 2007 STAP pump station to 20,000 m^3/d; increasing capacity 2011 LTAP pump station to 24,000 m^3/d; replacing pumps with VFD pumps to optimize energy use; and refurbishing /replacing hydraulic equipment (EMF meters, check valves, water hammer vessels etc.) For the Water Treatment Plant, the works will include improvement of treatment process through rehabilitation of sedimentation tanks; replacement of pumps with VFD units to optimize energy use; refurbishment/replacement of hydraulic equipment (check valves, water hammer vessels etc.); construction of buffer tank for sludge including pumping station; construction of static thickener for the sludge including pumping station; construction of sludge drying bed; and limited civil, electromechanical and electrical works

5.0 Objective of ESIA study

The general objective of the ESIA investigations is to carry out a systematic examination of the present environmental situation within the project area to determine whether the proposed project will impact adversely on the physical and biological elements of the environment within the project area. This is in line with Section 58 (1) of EMCA 1999 that requires project proponents to carry out ESIA on projects that appear in the Second Schedule of the Act.

6.0 Study methodology

The methodologies used included identification, collection, and analysis of environmental baseline data; identification of impacts; analyses and evaluation of impacts; formulation of mitigation measures for significant negative impacts; development and analysis of project alternatives, and development of environmental/social management and monitoring plans.

7.0 Study findings

A number of issues which have made it impossible for the plant to operate at optimal levels were noted during this assessment. It was noted during the study that the 1958 and 1985 pumping stations are old and in need of major rehabilitation works. Pumps at the 1958 and 1985 pumping stations operate with a very low efficiency. It was also noted that pumps at the 2007/2011 pumping station operate adequately (efficiency at around 72%). The 2 x 300 force mains have insufficient capacity to convey the total design output of the 1958 and 1985 pumping stations

(24,000 m³/d = 1,000 m³/h) to the Dunga Phase I and II WTPs. The current alignments and connections of the pipes at the intake are detrimental to the hydraulics of the system, lead to minor head losses and induce higher energy costs. Some electro-mechanical equipment, including meters, were noted to be failing or ill-fitted in all pumping stations, especially in 1958 and 1985 pumping stations; and some civil works are necessary; mostly repair of chamber, pipe supports and fence.

8.0 Public Consultation

Public participation in this project was achieved through consultation with the client and the neighbouring community. This was done through direct interviews and questionnaire administration. It emerged from the stakeholders' consultation that the project is welcome in the area as they do not anticipate any negative impacts from its construction and operation.

9.0 Impact Assessment Criteria

The criteria applied in this study are based on industry standards for impact assessment, adopted for use in the assessment of the proposed project impacts. The purpose of impact assessment is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The rating of impacts assumes that standard construction and operating procedures present in the project description will be implemented. The impact assessment criteria include the spatial context of project impacts; temporal context; and reversibility, magnitude and significance of potential impacts of project construction and operation. The potentially significant environmental and social impacts have been identified based on the nature of the receiving environment, analysis of the proposed activities and analysis of the issues raised by stakeholders during public participation process.

10.0 Existing Environmental and Social Impacts

A number of social and environmental impacts were noted at the raw water intake and the water treatment plant sites. Planned and existing developments may increase pollution loads of the lake at the intake point and may in the long run deprive the facilities of land for future expansion. This could pose significant challenges to the water supply provider if the steady growth of population of Kisumu city is to be considered. Flushing of sludge from the water treatment plant into Lake Victoria pollutes the lake water and should be addressed. More importantly, the design of the treatment plant should take into consideration need for sludge drying beds for sustainable management of sludge from the treatment process. It was also noted during this study that large volume of water is lost during sludge removal and it is important to note that raw water is pumped from the lake and any loss of water is loss of energy cost incurred in the pumping of water. This cost in normally passed on to the consumer.

11.0 Anticipated Environmental and Social Impacts

Environmental and social impacts associated with construction and operation phases of the proposed project include the following:

11.1 Impacts of obtaining construction materials

The project will require some amount of materials for construction of project related infrastructure. Extraction and transportation of these materials are associated with various impacts including land degradation, creation of mosquito breeding areas and dust pollution.

11.2 Accidents and Injuries to workers and residents

Work at the proposed site may involve hazards such as accidental falls into open trenches, slippery walkways, working at heights, and exposure to energized circuits, and heavy equipment which have the potential of causing accidents and injuries.

11.3 Solid waste generation

Construction will result in the generation of various solid wastes, principally surplus aggregates, metal scraps, plastics (wrappings and containers) and wood which will potentially lead to environmental pollution.

11.4 Atmospheric pollution

The expected air pollutants from the proposed project will include dust, particulate matter and gaseous emissions from construction materials. Dust will be generated from the excavations, batching activities, earth moving and materials delivery. Particulate matter will be generated by dry construction materials including sand, cement, gravel, murram, etc.

11.5 Noise pollution

Use of heavy construction machinery including excavators, water pumps and generators will lead to relative noise levels. Fabrication of site equipment and concrete mixing both at the contractor's workshop and at the construction site will generate significant noise levels.

12.0 Mitigation measures for adverse environmental and social impacts

Mitigation measures have been proposed for sustainable management of adverse impacts identified. They include the following:

12.1 Mitigation measures for impacts of obtaining construction materials

- Maximise the re-use of excavated materials in the works, as fill.
- Site quarries and borrow pits carefully so as to minimise impacts on existing land uses.
- Strip all available topsoil from borrow pits and quarries and store it safely for use in site restoration.
- Close all borrow pits and quarries in accordance with an approved plan to maximise their long-term biological productivity (capacity for plant growth) and minimise health and safety hazards.
- Carry out EIA for quarry site if new quarries are to be opened for purposes of this project.

12.2 Mitigation measures for accidents and Injuries to workers and residents

- The Contractor shall conform to all the stipulations of the Occupational Health and Safety Act, 2007. The Act requires the designation of a Health and Safety representative when more than 20 employees are deployed;
- The contractor shall provide ample warning signs, guard rails, warning tape, etc., around open excavations, stacks of material, debris, etc. and shall be held liable for all claims as a result of neglect of such precautions and provisions;
- Use of requisite Personal Protective Equipment (PPE) at all times during construction works

12.3 Mitigation measures for solid waste generation

- Bins/ receptacles shall be placed at strategic locations within the site as collection centres to facilitate separation and sorting of the various types of wastes;
- Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable to the supervising architect and environmental consultant;
- Construction site management plans will be required for all works. This plan will include a waste management plan for all activities during the construction period.

12.4 Mitigation measures for noise Impact

- Schedule road traffic movements to normal working hours (08H00 –17H00).
- Where need be, all exposed workers will be provided with functional ear muffs, whose use is mandatory, and closely enforced, monitored and supervised.

12.5 Mitigation measures for atmospheric Pollution

- Impose speed limits (10 km/h in all areas within the site boundaries).
- Damping down of access roads, stockpiles and cleared areas must take place to minimize dust pollution.
- Dust and air pollution due to dust when excavated material is stock piled, should be limited by means of wetting (particularly dry season), covering with foil or working in small sections so that the trenches are backfilled with excavated soil within shortest possible period (maximum 2 days).

13.0 Conclusions and recommendations

13.1 Conclusions

13.1.1 General

The raw water intake and Dunga Water Treatment Plant have operational deficiencies that need to be fixed if water supply issues are to be adequately addressed in Kisumu City. The gradual upgrading of the raw water intake over time has led to a rather cumbersome pumping and piping arrangement that may be linked with potential capacity restrictions. Dunga Water Treatment Plant also has capacity issues that need to be addressed. The facilities have aged over time and worn out parts should be replaced.

13.1.2 Anticipated environmental and social impacts

Significant environmental and social impacts are not anticipated from construction and operation of the proposed project. This is attributed to the fact that most of the proposed activities will be carried out within the boundaries of existing structures (in situ). Analysis of the anticipated adverse impacts revealed that most of the impacts are low in significance and can be adequately mitigated through implementation of the recommended mitigation measures contained elsewhere in this Project Report.

13.2 Recommendations

The following recommendations apply to the proposed project

13.2.1 Implement the project as proposed

From field survey and public consultation, it was noted that the proposed project will not lead to adverse environmental and social impacts to the neighbouring populations and land uses. Those consulted are also supportive of the project and the project should therefore be implemented as proposed.

13.2.2 Suspend development approval

Development execution within the vicinity of raw water intake and water treatment plant should be suspended. A buffer zone should be created around the intake and treatment facilities as a way of managing land use conflicts. Developments next to Raw Water Intake contribute to increase in pollution load of Lake Victoria and therefore straining treatment capacity of the plant while developments around the treatment plant deprive the facility of land for expansion.

13.2.3 Carry out survey of water treatment plant land

The extent of the land set aside for water treatment works should be established based on the original Title Deed. Once this is done, the Project Proponent should carry out survey of the area and fence off all the land originally allocated for purposes of water treatment plant. Titles of those who have encroached on the land should be revoked.

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Environmental and Social Impact Assessmentfor Works Package 2 Lot 2

Figures

Tables

Acronyms and Abbreviations

AFD	Agence Française de Développement
BRL	Bourg la Reine
CBD	Central Business District
CIDP	County Integrated Development Plan
DEAP	District Environment Action Plan
DMM	Delegated Demand Management
DN	Diametre Nominel
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMF	Electromagnetic Flow
EMP	Environmental Management Plan
ESAP	Environmental and Social Assessment Procedures
ESIA	Environmental and Social Impact Assessment

ESMP	Environmental and Social Management Plan
LVSWWDA	Lake Victoria South Water Works Development Agency
FGD	Focus Group Discussion
GoK	Government of Kenya
Ha	Hectare
KIWASCO	Kisumu Water and Sanitation Company
KWSSP	Kisumu Water Supply and Sanitation Project
LTAP	Long Term Action Plan
LTD	Limited
ISEP	Integrated Science and Engineering Projects Limited
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NRW	Non-Revenue Water
NGO	Non-Governmental Organisation
NLP	National Land Policy
NLC	National Land Commission
NPS	Nominal Pipe Size
NTU	Nepholometric Turbidity Units
O&M	Operation and Maintenance
OP/BP	Operational Policy/ Bank Procedures
OSHA	Occupational Health and Safety Act
PAC	Polyaluminium Chloride
PAP	Project Affected Person
PPE	Personal Protective Equipment
RAP	Resettlement action Plan
STAP	Short Term Action Plan
SOE	State of Environment
TOC	Total Organic Carbon
TOR	Terms of Reference
uPVC	Un-plasticised Polyvinyl Chloride
VFD	Variable Frequency Drive
WASREB	Water Services Regulatory Board
WHO	World Health Organisation
WSB	Water Service Board
WSTF	Water Service Trust Fund
WRMA	Water Resources Management Authority
WTP	Water Treatment Plant
WTW	Water Treatment Works

1. Introduction and Background Information

1.1 Introduction

The term "water quality" describes the physical, chemical and microbiological characteristics of water. These properties collectively determine the overall water quality and the fitness of the water for a specific use. These properties are either intrinsic to the water or are the result of substances that are dissolved or suspended in the water. Water quality is only meaningful when evaluated in relation to the use of the water. The reason is that water of a certain quality may be fit for a specific use, but completely unfit for another use. For example, water that is fit for human consumption may not be fit as boiler feed water because the dissolved inorganic salts that are acceptable in drinking water, are not tolerated in boiler feed water, since they may precipitate and cause blockages in the boiler equipment. Water that is fit for domestic use (drinking water) must comply with specific requirements. The most important requirement is that it must be safe to drink. Many raw water sources contain harmful micro-organisms or other substances in concentrations that make the water unsafe to drink or in other ways unfit for domestic use. These organisms and substances must be removed from the water by means of treatment processes to make the water fit for domestic use. In addition to the requirement that water must be safe to drink, water for domestic use must also be aesthetically pleasing (have a clean appearance, taste and odour) and it must furthermore be chemically stable (i.e. it must not cause corrosion or form deposits in pipes or fixtures such as geysers).

1.2 Project Background and Rationale of Environmental and Social Impact Assessment Study

The city of Kisumu is located in Western Kenya, on the shores of Lake Victoria, the second largest fresh water lake in the world. Kisumu is the third largest city in Kenya with a population of about 260,000 inhabitants, among 970,000 at the scale of the County. The public water supply and sanitation services in Kisumu city had deteriorated into a deplorable state of repair by the early 2000's, due to a lack of public investment since the 1980's and subsequent lack of maintenance by the former Kisumu Municipal Council. At this time, almost 50% of the population had no access to the water and sanitation services and were also receiving water of poor quality at a high cost. Furthermore, only 50% of the residents had uninterrupted services.

Following the inception of the Lake Victoria South Water Works Development Agency (LVSWWDA) as the asset holding and development agency responsible for the water and sanitation services in Kisumu city under the Water Act 2016 (Now Lake Victoria South Water Works Development Agency -LVSWWDA), the Kisumu Water Supply and Sanitation Project (KWSSP) was initiated by the Ministry of Water and Irrigation to develop the water supply and sanitation systems to adequately serve a projected population in the service area of 663,000 by the year 2031. LVSWWDA was the executing agency with overall responsibility for implementation of the Project. In this context, the French Development Agency's (AFD's) intervention in Kisumu began in 2005 with the financing of the Kisumu Water Supply and Sanitation Project (KWSSP). This project was undertaken in two steps namely Short Term Action Plan (STAP) and Long Term Action Plan (LTAP)

Short Term Action Plan was meant to restore the capacity of the existing system to near design, which was completed in 2007 and mainly consisted of rehabilitation of the Dunga source works (Lake Victoria) to deliver 21,500m³/day and rehabilitation and extension of the distribution system. These works were implemented between 2006 and 2007. Long Term Action Plan was divided into two phases. Phase 1 consisted of emergency works, to increase the capacity of the Dunga source to 45,500m³/day. These include construction of a raw water transmission pipeline and associated infrastructure and construction of a 24,000 m³/day Water Treatment Plant including chemical house, storage tank and associated infrastructure). These works were implemented between 2009 and 2011 but were not substantially completed.

Based on the above background, Lake Victoria South Water Works Development Agency (LVSWWDA) has retained BRL, ISEP LTD and SCET TUNISIE JV to carry out feasibility study and audit of Dunga Water Treatment Plant and improve the treatment plant on the basis of audit results. The audit carried out on the two facilities discovered a number of deficiencies both at the Intake and at the Water Treatment Plant and has proposed rehabilitation of both Intake works and water treatment facility. This Environmental and Social Impact Assessment has therefore been carried out in compliance with section 58 (1) of Environmental Management and Coordination Act (EMCA) 1999 and aims to carry out a systematic examination of the present environmental situation within the project area to determine whether the proposed works will impact adversely on the physical and biological elements of the environment within the project area.

1.3 Need For Rehabilitation of Dunga Raw Water Intake and Water Treatment Plant

The gradual upgrading of the raw water intake over time has led to a rather cumbersome pumping and piping arrangement that may be linked with potential capacity restrictions. Lower pumped flows can lead to early wear of equipment: for instance, the two check-valves in operation on the DN400 line exiting the new building do not function properly. The intake area as presently located is also predisposed to pollution from the several enterprises located within the vicinity of the intake site. The site would benefit from a thorough re-examination to rationalize pumping and remove unnecessary cross-connections.

Regarding Dunga Water Treatment Plant, a number of issues which requires urgent attention were noted during the audit. Presently, sludge builds-up after 8 days, which will become an even more severe issue when demand increases. Potential reasons include the fact that raw water turbidity lies between 70 and 200 NTU. The intake is fine and the problem seems to be located at the WTP. There seems to be a sedimentation tank design deficiency in sludge settling and removal. The sludge removal process usually involves alternate emptying of the tanks. This results in large volumes of water being lost from the system as there is no recirculation system in place. Highlift pumps at Dunga WTW do not work at an efficient pumping regime. Discharge valves in clear water pumping stations are not motorized and it is needed to start pumps against partially closed valves in present situation. Measurement and monitoring of Dunga water supply system is also not effective. The bulk water meters previously installed, have challenges of malfunctioning. The above state of affairs calls for rehabilitation of both the intake works and water treatment plant.

1.4 Objectives of The Project

The principal objective of the project is to rehabilitate and improve structures and facilities at Dunga Raw Water Intake and Water Treatment Plant to make them effective in the water treatment process.

1.5 Scope of Works

The proposed works will be carried out at the Raw Water Intake, Transmission Mains and Water Treatment Plant as follows:

1.5.1 Dunga Raw Water Intake

The works will include the following:

- Decommission of 1958 and 1985 (Option 2) pump stations
- Increase Capacity 2007 STAP pump station to 20,000 m³/d
- Increase Capacity 2011 LTAP pump station to 24,000 m³/d
- Increase pump head (duty point) to 25m or 30m (if Process Changes at Dunga WTP requires it)
- Replace pumps with VFD pumps to optimize energy use

- Refurbish/replace hydraulic equipment (EMF meters, check valves, water hammer vessels etc.)

1.5.2 Transmissions Mains

The works will include the following:

- Refurbish/replace air valves/washouts
- Replace defective valves
- Flush mains, remove air locks

1.5.3 Water Treatment Plant (WTP)

The works will include the following:

- Improve treatment process through rehabilitation of sedimentation tanks
- Replace pumps with VFD units to optimize energy use
- Refurbish/replace hydraulic equipment (check valves, water hammer vessels etc.)
- Improve ventilation and lifting equipment in pump stations
- Rehabilitation of 2007 pumping station building
- Replacement of existing gate valves, flow meters and electromechanical meters
- Construct transformer house
- Repair chemical dosing tanks and roof of chemical dosing building
- Construction of buffer tank for sludge including pumping station
- Construction of static thickener for the sludge including pumping station
- Construction of sludge drying bed; and
- Limited civil, electromechanical and electrical works

1.6 SIGNIFICANCE OF THE PROJECT

The following will be achieved as a result of implementation of the proposed project:

- Better access to safe drinking water leading to improved standards of living; and changes in exposure to both communicable and non-communicable diseases;
- Improvements in domestic hygiene and a reduction in health risks that have all along been associated with poor water quality or inadequate access to sanitation services;
- Management of cases of burst sewer pipes that currently leads to pollution of surface and ground water resources;
- Local people will be granted the opportunity to channel their wastewater in a properly functioning system;
- Promotion of a more sustainable use of water resources with improvements in the infrastructure to reduce losses and introduction of better metering and billing procedures to encourage more efficient use of water;
- A comprehensive metering program (of production and consumers) during expansion of water supply infrastructure is expected to reduce the present rate of Non-Revenue Water (NRW) (technical and commercial losses) to a more acceptable level; and
- General improvements in service reliability and pressure levels.

1.7 OBJECTIVES OF THE STUDY

1.7.1 General Objective

The general objective of this environmental and social Impact assessment was to carry out a systematic examination of the present environmental situation within the project area to determine whether the proposed project activities will adversely impact on the physical and biological elements within the project area. This is in compliance with Section 58 (1) of Environmental Management and Coordination Act (EMCA) 1999 that requires proponents to carry out ESIA on projects that appear in the Second Schedule of the Act.

1.7.2 Specific objectives of ESIA Study

Specific objectives of this ESIA include the following:

- To highlight environmental issues of the proposed project with a view to guiding policy makers, planners, stakeholders and government agencies in understanding the implications of the proposed project on environmental elements within the project area ;
- To review existing legal, institutional and policy framework relevant to the proposed project ;
- To anticipate environmental and social impacts associated with implementation of the proposed project with a view to coming up with mitigation measures for adverse impacts noted ;
- To assess the relative importance of the impacts of alternative plans, design and sites;
- To generate baseline data for monitoring and evaluation of how well the proposed mitigation measures are implemented during the project operation period;
- Develop an Environmental and Social Management Plan (ESMP) to guide in decision making and for future auditing;
- Raise stakeholder awareness on the impact of the project on the environment; and
- Develop an ESIA report in conformity with the EMCA 1999 and Environmental (Impact Assessment and Audit) Regulations 2003.

1.8 SCOPE OF THE STUDY

The study has been conducted to evaluate the potential and foreseeable impacts of the proposed development. The physical scope is limited to the proposed site and the immediate environment as may affect or be affected by the proposed project and associated infrastructure. Any potential impacts have been evaluated as guided by EMCA 1999 and the Environmental (Impact assessment and Audit) Regulations 2003. This report includes an assessment of impacts of the project on the proposed site and its environs with reference to the following key issues:

1.8.1 Review of policy, legal and administrative framework

Several policies, legal and administrative arrangements and protocols that have direct relevance to the proposed development were reviewed. This was in an attempt to establish the frameworks within which the significance of the various impacts anticipated due to implementation of the proposed project can be evaluated. A lot of emphasis has been placed on legal and policy frameworks that have a direct relevance to water and sanitation sector. These include the constitution of Kenya 2010, Kenya Vision 2030, National Environment Policy 2013, EMCA 1999, Water Act 2016 and Water Quality Regulations 2006 among others. International agreements and conventions that are relevant to the water and sanitation sector and which have been reviewed include the Vienna Convention for Protection of Ozone Layer, United Nations Framework Convention on Climate Change, RAMSAR Convention on wetlands of international importance and United Nations Convention on Biological Diversity, 1992. World Bank guidelines relevant to the proposed project including OP/BP 4.01 on Environmental Assessment; OP/BP 4.04 on Natural Habitats; OP 15.50 on Disclosures; and OP/BP 4.12 on Involuntary Resettlement have also been reviewed. These have formed the basis for the determination of the significance of the various impacts associated with the proposed project.

1.8.2 Description of the proposed project

The proposed project has been described in terms of location and physical characteristics of the project area; design of the water and sewerage systems; products, by-products , waste and waste management methods. This approach has been pursued since it makes it possible to know the likely sources of impacts, how the impacts relate to one another in terms of being direct, indirect, cumulative, reversible etc. in order to propose sustainable mitigation measures for the management of adverse impacts noted.

1.8.3 Review of the baseline information

Baseline information forms the basis of degree and magnitude of the impact since they give the conditions of the environment in terms of resources and impacts before implementation of the proposed project and associated infrastructure. This helps in the monitoring exercise and for that matter, brings into focus the extent of the accuracy of the prediction of the impacts in question.

1.8.4 Assessment of the potential environmental impacts

Assessment of environmental impacts on the biophysical, socio-economic, religious and cultural aspects is the very reason why any ESIA study is carried out. Environmental aspects associated with any project are normally felt on natural or human elements. It is the direction, magnitude and extent of the impacts on these elements that make the impact either positive or negative. These are the various social and physical parameters that are in continuous interplay within the general environment of any project and it is how the project will affect or will be affected by these parameters that eventually lead to positive or negative perception in environmental terms.

1.8.5 Proposition of alternatives

Any planning activity must work towards giving sustainable alternatives with regard to resource allocation. ESIA as a planning tool must therefore give options that can be pursued in order to get sustainable results. The alternatives in this project have been looked at in terms of product mix, site, technology, design, scale and extent. The comparisons of these with the proposed project option give rise to the best project option.

1.8.6 Development of mitigative measures

Mitigative and management measures are meant to limit the extent of negative impacts that may arise as a result of a particular development alternative. Potentially negative environmental impacts of a project may be tolerated by both environmental elements and neighbouring populations depending on the mitigative measures proposed for implementation. Measures to manage adverse impacts associated with implementation of the proposed project have been included in this report to promote sustainable development principles.

1.9 Environmental and Social Impact Assessment (ESIA) Team

The ESIA study was conducted by a team of professionals drawn from various disciplines who ensured that all matters relating to the project as it impacts on the neighbouring environment were adequately covered and critical stakeholders consulted. Table 1.1 below gives a summary of ESIA team composition and tasks assigned to each member of the team.

Table 1.1: ESIA Team Composition and task assignment

No	Name	Position	Task
1	Eng. Caleb Opati	Project Director / Water Treatment Specialist/ Civil Engineer	■ Liaise with the Client to ensure that the project is carried out as provided for in the contract; ■ Define tasks and work programmes for all Consultants; ■ Maintain quality control of all works; ■ Prepare all technical documents/reports relevant to the assignment; ■ Ensure that adequate resources are allocated to the field team; ■ Liaise with field team to ensure that data collection exercise is carried out as per schedule; ■ Work in consultation with the Team Leader for expeditious delivery of outputs; ■ Coordinate report writing; ■ Chair all review and consultative meetings; ■ Establish and maintain quality control; ■ Maintain work standards by ensuring that reporting schedules are adhered to; ■ Manage the flow of information between Field Team and the Joint Venture; and ■ Participate in any activity that may require your expertise.
2	Amimo Odongo	EIA Lead Expert and Team Leader	■ Review of environmental policies, legislative and institutional frameworks; ■ Review of data on planned and existing key development projects proposed for implementation within the project area; ■ Collection of baseline data on environmental conditions; ■ Assessment of the impacts of future similar

			projects on the environment within the project area; ■ Gather data and information on existing environmental problems within the project area; ■ Propose measures to mitigate existing and future adverse impacts; ■ Consider options to improve the environmental benefits; ■ Carry out analysis of alternative means of implementing the projects; ■ Recommend feasible and cost effective mitigation measures for negative impacts; ■ Develop an Environmental/Social Management and Monitoring Plan; ■ Lead field team and ensure that data collection exercise is carried out as per schedule; ■ Coordinate report writing and ensure that all relevant information are included in the report; ■ Compile Draft and Final ESIA Reports; ■ Present draft reports to the Client as per schedule; and ■ Incorporate Comments from the client into the draft report and prepare final report
3	Christine Amondi Ponde	Sociologist	■ Review environmental policies, legislative and institutional frameworks; ■ Review available reports and documents from previous studies; ■ Asses the impacts of future similar projects on social environment within the project area; ■ Gather data and information on existing social problems within the project area; ■ Carry out social analysis of potential impacts using PRA methods; ■ Carry out analysis of the implications of anticipated emergence of new social challenges with the aim of recommending appropriate mitigation measures; ■ Consider options to improve social benefits; ■ Carry out analysis of alternative means of implementing the projects; ■ Recommend feasible and cost effective mitigation measures for negative social impacts; ■ Develop a Social Management and Mitigation Plan; and ■ Develop a monitoring plan;

4	Julius Omondi	Assistant Engineer- Water and Sanitation	■ Review of technical drawings to ensure that they meet the required standards for projects of this nature; ■ Review of data on baseline environmental conditions of the project area including soil to ascertain their suitability for the proposed project; ■ Review of technical documents related to the project ■ Stakeholder engagement on technical aspects of the project; ■ Consideration of options to improve project benefits; ■ Carrying out analysis of alternative means of implementing the projects; and ■ Recommending feasible and cost effective mitigation measures to prevent or reduce significant negative impacts identified to acceptable levels.
5	Stephen Ochieng	Environmentalist	■ Review of environmental policies, legislative and institutional frameworks; ■ Review of data on planned and existing key development projects proposed for implementation within the project area; ■ Collection of baseline data on environmental conditions; ■ Assessment of the impacts of future similar projects on the environment within the project area; ■ Gather data and information on existing environmental problems within the project area; ■ Proposition of measures to mitigate existing and future adverse impacts; ■ Consideration options to improve the environmental benefits; and ■ Recommendation feasible and cost effective mitigation measures for negative impacts;
6	Cynthia Shitsukane	Assistant Engineer- Water and Sanitation	■ Review of technical drawings to ensure that they meet the required standards for projects of this nature; ■ Review of data on baseline environmental conditions of the project area including soil to ascertain their suitability for the proposed project; ■ Review of technical documents related to the project ■ Stakeholder engagement on technical aspects of the project; ■ Consideration of options to improve project benefits;

			■ Carrying out analysis of alternative means of implementing the projects; and ■ Recommending feasible and cost effective mitigation measures to prevent or reduce significant negative impacts identified to acceptable levels.

1.10 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OUTPUTS

The following are the outputs of this Environmental and Social Impact Assessment study:

- A detailed Environmental and Social Impact Assessment report outlining baseline environmental conditions, project description, project alternatives, environmental impacts and mitigation measures proposed.
- A comprehensive Environmental Management Plan (EMP) detailing institutional structure with respect to safeguards implementation; roles and responsibilities of the environmental personnel of the contractor and other stakeholders in the project; capacity building requirements, and consultant support required; and costs for implementation of mitigation measures and provisions for monitoring of environmental parameters during construction and operation phases of the project including any capacity building requirements.

2. Environmental and Social Impact Assessment Methodology

2.1 General

The purpose of conducting the ESIA study was to ensure that the proposed project is environmentally sound and fits well within existing land uses. The study has described and quantified impacts associated with the proposed project on the physical environment and neighbouring populations and land uses. The activities for the ESIA involved desk studies and fieldwork that included direct interviews transect walks and direct observations leading to the preparation of this Project Report. Below is a detailed description of activities undertaken during the study

2.2 Reconnaissance Visit

This was the initial site acquaintance visit whose main aim was to understand the project area, identify constraints, and develop impressions on topography, soils, existing developments and practicality of developing water and sanitation infrastructure within the proposed area. It also marked the major inception meeting with representative of project proponent and local administration offices represented in the area to pave way for further involvement of their officers in subsequent meetings and consultations. The main objective of these meetings was to agree on expectations of the assignment, its execution procedure, focal and reference points of the proposed project and work plan. An inception report for the study was prepared at this stage.

Figure 2.1 Consultation with stakeholders during reconnaissance visit

2.3 LITERATURE REVIEW

This is an indirect method of data gathering and published data both in the Internet and from physical sources were collected. Both quantitative and statistical information from relevant secondary sources including various documents and reports on project area and Kisumu County in general were collected and reviewed. This helped in the identification of the gaps existing in the available information and enabled the ESIA team to arrange to undertake detailed field investigations. Special emphasis was placed on climate; hydrology; soils; national environmental laws and regulations; human population and settlements; and socioeconomic infrastructure within the project area. Literature review involved review of the following data associated with the project area.

2.3.1 Hydrology and Water Quality

The assessment of hydrological and water quality conditions in the study area were based on review of topographic maps, review of relevant reports, and on-site field inspections. Field inspections included observation of slopes and drainage on the sites. Evidence of slope instability was sought. The potential relationship between drainage courses and adjacent trails was examined, as was the effect of vegetation on surface soil conditions and water quality. The locations of storm drains discharging into natural drainage courses were noted, as were the effects of these discharges on flows and erosion features.

2.3.2 Vegetation

The assessment of the potential effects of project construction on vegetation was considered within the proposed project site, buffer areas and regional area. The Project site includes areas that will be directly disturbed by project construction. Buffer areas (adjacent areas) include a 1 km wide area surrounding the project site. The regional area specified in this assessment includes areas outside the 1km buffer area.

A review of publicly available data, existing information, literature and other data was completed before initiating fieldwork. This office-based review included the examination of maps to determine the extent of natural vegetation on the sites and the variability in vegetation composition. The review also included previously completed reports on the vegetation of the study areas and sensitive ecosystem inventory mapping of the sites. Information about rare and endangered plant species and plant communities was obtained from the State of Environment Report. Information provided through interviews with knowledgeable people from the project area was incorporated into the baseline data.

The initial field visits were conducted within the study area between September 2017 and March 2018 to confirm vegetation composition and distribution of the existing vegetation features of the project sites. The second round of field visits was cried out within the project area in August 2019. This helped in ascertaining changes that may have occurred in vegetation composition since the initial site visits.

2.3.3 Wildlife and Wildlife Habitat

The assessment of the potential effects of project construction on wildlife considered wildlife use, habitat and habitat features. A review of publicly available data, existing reports and literature was completed before initiating field work. Information collected during the office-based review was used to identify potential habitat for rare and at-risk wildlife.

Field surveys were conducted along the proposed pipeline routes and neighbouring areas. Wildlife specialists walked within these areas and documented topography; observed wildlife species; noted wildlife habitat and habitat features (e.g., wildlife trees, stick nests, and perch trees); and searched for signs of use by rare or at-risk wildlife. A "purposeful meander" technique was used to survey the areas and more detailed searches were performed at locations where potentially important habitat or habitat features were observed.

2.3.4 Fish

The proposed Dunga Raw Water Intake and Water Treatment Plant works is located within Kisumu city which sits at the shores of Lake Victoria. Project activities are therefore likely to have significant impact on fish species. Information on the main water resources within the project area including lakes, rivers, dams and wetlands was gathered. The pollution levels of these water resources were looked at from the point of view of being habitats to various fish species. Information on the variety of fish stocks in these water bodies including native and introduced species were gathered from secondary sources. The impacts of the proposed project on fish stocks within the local water bodies were ultimately assessed

2.3.5 Land Use

The Land use section of this ESIA builds on information collected for the siting analyses, which included a review of existing planning documents, site visits, and discussions with representatives of the client and government officials to understand existing and planned land uses and potential impacts of the proposed works on these land uses. News articles, media releases, and information on other community initiatives were also reviewed to understand the regional and local context. A lot of data was borrowed from the feasibility study and design documents. Visits to the sites were conducted by the ESIA experts to confirm the use of the sites and adjacent land by property owners and local residents.

2.3.6 Traffic

To determine traffic flow within the project area roads, the ESIA team reviewed relevant traffic flow data, plans, and reports and inspected the relevant routings and road and railway system within the affected neighborhoods during site visits. This was done to determine the existing vehicular volumes on preferred route to the proposed facility, including accident history where available and also to identify the order of magnitude of current pedestrian and bicycle traffic in the transportation corridors of the preferred routes and how this may be impacted on by construction activities. The data review also helped in forecasting the type and amount of traffic that would be generated by the project during construction period and identifying any relevant transportation and traffic related issues that may arise during construction process. The level of impact of traffic on affected neighborhoods and road users were noted and potential mitigation measures to reduce or avoid traffic impacts suggested.

2.3.7 Noise and Vibration

The Noise and vibration section has been prepared based on facility design information and adjacent land uses. The ESIA experts surveyed the area identifying the existing sources of noise impacts and comparing this with the project situation. Noise and vibration effects during facility construction are assumed to be the same as a typical construction project and to follow all applicable municipal bylaws. Based on the foregoing assumptions, potential effects of noise and vibration on surrounding areas were identified and mitigation measures proposed.

2.3.8 Human Health

The assessment of the potential effects of project construction on human health was considered within project alignment areas. Data on existing baseline information in terms of site conditions, land uses within project alignment areas, neighbouring facilities and their distances from the project site, any other unique feature of the project area that may be affected by project construction and operation activities were collected and analyzed. Information on water quality and access, prevalent diseases within the project area, solid waste and wastewater management, sanitation issues and physical and biotic factors were collected and analyzed. Existing conditions of infrastructure including roads, water supply, noise generating activities and whether there are any pollution sources within project vicinity was analysed. The collected data was used to assess potential impacts on health, safety and the environment both to the workers and the local community during construction and operation phases of the project.

2.3.9 Visual Aesthetics

Visual impacts are changes to the scenic attributes of the landscape brought about by the introduction of visual contrasts (e.g., development) and the associated changes in the human visual experience of the landscape. Visual impacts in this project arise from changes in available view of the landscape due to location of the project and associated infrastructure. Visual impacts in this study were determined through the subjective assessment of the visual receptors (i.e. residents, outdoor recreational areas etc) and the magnitude (scale) of the change in view. Sensitivity were looked at from the point of view of receptors location; the importance of receptor views; their activity (i.e. working, recreation or travelling through); expectations; available view; and the extent of screening of this view. These visual elements were considered in the assessment in comparison with present conditions.

2.4 Field Visits

Field studies were undertaken to evaluate the types, mode of action and magnitude of the specific projected effects and impacts, both favourable and detrimental to the environment, natural resources and neighbouring land uses. This encompassed detailed study and analysis of water resources, sensitive ecosystems, proposed water and sewerage pipeline routing, human settlements, health and safety issues as well as general structure of the physical, biological and socio-economic environment. Transect walks were undertaken to review the informal settlements, the existing water supply and sewerage infrastructure and to identify the potential impacts of implementation of the proposed project on existing land uses. Transect walks were also undertaken to gather baseline data through observation of land use in close proximity to and within the proposed project area. Scenes of environmental and social significance were captured through photographs.

2.5 Key Informant Interviews

One-on-one interviews with representatives of the client and community members was undertaken to assist in gathering data and analysis of impacts to the local community and land uses within the project area. Key informants drawn from Kisumu Water and Sanitation Company (KIWASCO), County Government of Kisumu and Lake Victoria South Water Works Development Agency (LVSWWDA) were interviewed during the ESIA process. These interviews were conducted to augment and confirm data and information obtained using the other tools and methods.

3. Project Description

3.1 Nature of The Project

The proposed works will involve rehabilitation and improvement of Dunga Raw Water Intake and Treatment systems. At the Dunga Raw Water Intake, the works will involve the decommission of 1958 and 1985 pump stations; increasing capacity 2007 STAP pump station to 20,000 m³/d; increasing capacity 2011 LTAP pump station to 24,000 m³/d; replacing pumps with VFD pumps to optimize energy use; and refurbishing /replacing hydraulic equipment (EMF meters, check valves, water hammer vessels etc.) For the Water Treatment Plant, the works will involve improvement of treatment process through rehabilitation of sedimentation tanks; replacement of pumps with VFD units to optimize energy use; refurbishment/replacement of hydraulic equipment (check valves, water hammer vessels etc.); construction of buffer tank for sludge including pumping station; construction of static thickener for the sludge including pumping station; construction of sludge drying bed; and limited civil, electromechanical and electrical works

3.2 Situation at Dunga Raw Water Intake and Treatment Plant (WTP)

The following describes existing facilities at the Dunga Raw Water Intake and Treatment Plant:

3.2.1 Situation at Dunga Raw Water Intake

Dunga Raw Water Intake consists of the following facilities and infrastructure

3.2.1.1 Old Pumping Station 1958

The design capacity of the 1958 pumping station is 10,000 m³/ d. Its current output is lower. The 1958 facilities include the following:

- Intake house #1 (Lake Victoria) with 4 x raw water suction pipes (2 x DN 225 and 2 x DN 150) each equipped with a strainer and foot valve;
- 1958 pump house with 4 x horizontal pump sets;
- Valve DN200 PN10 and check valve at each pump outlet;
- Two DN300 rising mains (steel);
- Two DN300 valves (one on each DN300 rising main) allowing to isolate the 1985 pumping station; and
- Two Woltmann type DN300 water meters (one on each of the DN300 rising mains)

3.2.1.2 Old Pumping Station 1985

The design capacity of the 1985 pumping station is 14,000 m³/ d. Its current output is much lower as only 2 (pumps #5 and #9) of the 5 pumps installed are currently operational .The 1985 facilities including the following:

- Intake house #2 (Lake Victoria) with 4 raw water suction pipes DN 200 each equipped with a strainer and foot valve;
- 1985 pump house with 4 horizontal pump sets;
- One separate intake (Lake Victoria) with raw water suction pipe DN200 with strainer and foot valve; one horizontal pump set; and one single acting DN50 air valve on DN200 rising main;
- Valve DN200 PN10 and check valve at each pump outlet;
- One DN400 rising main (steel);

- One Woltmann type DN300 water meter on DN400 rising main; and
- DN300 valve on DN400 rising main before connection with DN300 steel main from 1958 pumping station.

3.2.1.3 New Pumping Station 2007 and 2011

The design capacity of the 2007 and 2011 pumping station is 21,000 m³/ d. Its current output is lower. The 2007 and 2011 facilities include the following :

- Intake house #3 (Lake Victoria) with 5 raw water suction pipes (steel) DN 250 each equipped with a strainer and foot valve;
- New pump house with 5 x horizontal pump sets;
- Valve DN250 PN16 and check valve DN250 PN10 at each pump outlet;
- Closed PN16 DN400 valve on rising main separating pump sets 1, 2 and 3 on the eastern side (pump to Phases I and II WTP) and pumps 4 and 5 on the western side (pump to Phase III WTP); and
- Two parallel force mains (steel) DN400 at pumping station outlet eastern and western mains):

Figure 3.1 2007 and 2011 pumping station

3.2.2 Situation at Dunga Water Treatment Plant (WTP)

Dunga Water Treatment Plant (WTP) was constructed in three phases including Phase I which was constructed in 1958, Phase II constructed in 1985 and Phase III constructed in 2011. The reported maximum capacity of Phases I and II is between 700 m³/ h (16,800 m³/ d) and 900 m³/ h (21,600 m³/ d). The current flows to Phases I and II WTPs is around 300 m³/ h (7,200 m³/ d), while the reported design capacity of Phase II WTP is 1,000 m³/h (24,000 m³/d). The current flow to Phases III WTP is around 600 m³/ h (14,400 m³/ d).

3.2.2.1 Phase I WTP

Phase I WTP comprises a number of structures including contact tank (common to Phases I and II), eight Flocculation Basins; eight Sand Filters; one Circular 600 m³ clear Water Tank, where HTH (calcium hypochlorite) is injected for disinfection; one Pumping Station; and two DN225 force mains to CBD, Milimani, Nyalenda and Nyamasaria;

3.2.2.2 Phase II WTP

Phase II WTP comprises contact tank (common to Phases I and II); three Flocculation/Sedimentation Basins; four Sand Filters; one Rectangular 760 m3 clear Water Tank, where HTH (calcium hypochlorite) is injected for disinfection; one Pumping stations with 5 pump sets; one DN 350 steel main to town and Kibuye tanks; and one DN600 steel main to Watson and Kibuye tanks;

3.2.2.3 Phase III WTP

Phase III WTP comprises inlet channel where Al2SO4 and Soda are injected ; coagulation tank ; flocculation tank ; two sedimentation tanks ; four Sand Filters ; one Circular 1,400 m3 clear water tank, where HTH (calcium hypochlorite) is injected for disinfection ; one Backwash elevated tank of 108 m3 ; one Pumping Station with two pump sets and one DN400 steel main connecting to the DN600 at the outlet of Phase II pumping stations.

3.2.3 Situation at the Sludge Treatment Process

The current situation does not allow for a proper sludge collection system from the decantation tanks. In the initial design, it was foreseen that the sludge bottom layer would be drained through a single flush outlet. Experience shows that operators are not able to extract the sludge, either from drainage, or from manual cleaning (due to a lack of access to the tanks). Moreover, the outlet pipe of the existing sludge chamber which collects water from the flush outlet of the decantation tanks is almost fully clogged. As a consequence, when the tanks are emptied, the sludge chamber overflows and the WTP compound is partially flooded. No sludge treatment is currently carried out. Due to the significant length of the tanks (more than 40m), the drainage system seems to be inappropriate to collect the sludge over the whole length. Currently, the operator is emptying the tanks weekly to desludge them but this manages only to collect a small part of the sludge. This operation is not only ineffective, it is also costly.

3.3 ISSUES NOTED DURING THE STUDY

3.3.1 Issues noted at the Dunga Raw Water Intake

A number of issues which have made it impossible for the plant to operate at optimal levels were noted during this assessment. They include the following:

- Works are required at pumping station intakes to limit the ingress of water hyacinths;
- The 1958 and 1985 pumping stations are old and in need of major rehabilitation works;
- Pumps at the 1958 pumping station operate with a very low efficiency (≤ 30%);
- Pumps at the 1985 pumping station operate with a very low efficiency (< 30%);
- Pumps at the 2007/2011 pumping station operate adequately (efficiency at around 72%);
- Power factor correction capacitors should be installed;
- The 2 x 300 force mains have insufficient capacity to convey the total design output of the 1958 and 1985 pumping stations (24,000 m³/d = 1,000 m³/h) to the Dunga Phase I and II WTPs;
- The current alignments and connections of the pipes at the intake are detrimental to the hydraulics of the system, lead to minor headlosses and induce higher energy costs;
- Some electro-mechanical equipment, including meters, are failing or ill-fitted in all pumping stations, especially in 1958 and 1985 pumping stations; and
- Some civil works are necessary; mostly repair of chamber, pipe supports and fence.

3.3.2 Issues noted at the barrier against water hyacinths

Water hyacinth (Eichhornia crassipes) has been widely described as one of the world's worst weeds. It is a free-floating and highly invasive aquatic plant that rapidly forms dense and impenetrable floating mats in freshwater systems. Near water intake pipes, water hyacinths can be sucked up and cause clogging of the pumps. To remedy this problem, it is essential to keep these plants away. The barriers are essential to filter the water and promote the influx of water necessary for the proper functioning of the pumps. In spite of the efforts of the station's agents, the thrust of the plants stuck to the fence continues to destabilize the structure, which makes difficult to protect the water intakes

Figure 3.2 Existing water hyacinth barrier at Dunga intake

3.3.3 Issues noted at the Water Treatment Plant (WTP)

3.3.3.1 Phase I WTP

At Phase I WTP, it was observed that the reagent mixing at the inlet of the WTP (contact tank) is not ideal (insufficient energy) while the sand filters are not regulated, and devoid of sand. Water height increases until the filter is backwashed (once a day). The filter gallery hydraulic equipment is in an acceptable condition and the filter backwash procedure is not effective. It was also observed that the catwalks and handrails need to be refurbished and the concrete slabs over channels and drains need to be replaced with removable non corrosive catwalks. Cracks were noted in the some of the civil structures.

3.3.3.2 Phase I WTP

At phase II WTP, it was noted that the reagent mixing at the inlet of the WTP (contact tank) is not ideal (insufficient energy) and there is an important (2.5m to 3m) headloss between the flocculation/sedimentation basins and the sand filters. The sand filters were noted not to be regulated, and devoid of sand. Water height increases until the filter is backwashed (once a day). It was also noted that the filter backwash procedure is not effective and the catwalks and handrails need to be refurbished. The metallic sheeting over channels and drains needs to be replaced with removable non-corrosive catwalks. Cracks were noted in the some of the civil structures.

3.3.3.3 Phase III WTP

At Phase III WTP, absence of level sensor and logger at inlet V Notch weir and absence of mixers in coagulation and flocculation basins were noted. The sand filters are not regulated, and devoid of sand. Water height increases until the filter is backwashed (once a day) while the filter backwash procedure is not effective. Cracks were noted in some of the civil structures. Some mixers and dosing pumps in chemical building are not operational.

Figure 3.3: Sedimentation basin (new line)

3.3.4 Issues noted at the pumping Stations

3.3.4.1 Sedimentation basin (new line)

At Phase I Pumping Station, it was observed that only one pump is in operation at any given time due to insufficient capacity of distribution network while the pumping station's E&M equipment needs to be entirely replaced. The check valves at pump outlet need to be replaced and water hammer calculations to be performed and anti-water hammer devices need to be installed if required. Inadequate lifting equipment (tripod only) were also noted at this pumping station. Other things noted include insufficient ventilation of the pump room. The DN200 Woltmann meters installed directly upstream of the DN200 EMF meters should be removed to provide a minimum of 5 x DN straight run upstream of the EMF meters.

3.3.4.2 Phase II Pumping Station

At Phase II Pumping Station, it was noted that only 2 of the 5 pumps are operated at any given time. The hydraulic equipment in is reasonable condition although inlet and outlet pipe geometry is far from ideal (headlosses are generated). Electrical and Mechanical equipment are in reasonable condition although the check valves at pump outlet need to be replaced. Lack of lifting equipment and insufficient ventilation of the pump room were also noted. The outlet EMF meter chambers were found to be flooded.

3.3.4.3 Phase III Pumping Station

The Phase III Pumping Station was not operational at time of the site visits (February 2018). Reportedly, electrical problems led to motor failure. The E and M equipment however need to be replaced. Inadequate lifting equipment (tripod only) was noted at the pumping station while the pumping station was partially flooded (via an inlet duct).

3.4 PROPOSED MEASURES FOR DUNGA RAW WATER INTAKE AND TREATMENT PLANT

Due to the above mentioned deficiencies on the Raw Water Intake and Treatment Plant, the proponent intends to rehabilitate and improve the facilities to make them efficient in their functions. This will be done through rehabilitation and improvement of facilities and structures as discussed below.

3.4.1 Construction of prefabricated reinforced concrete structure as barrier against water hyacinth

A sustainable solution to water hyacinth problem consists of placing the water intakes in a structure protecting the intakes from the intrusion of water hyacinths while offering sufficient water flow for its needs. The structure can be prefabricated and placed around the water intake using a mobile crane. The elements of the structure will be placed on the bottom of the lake (with a resistant seabed) and tightened one by one under the effect of their weight. Metal grid windows would allow the structure to be filled with water. These grilles can be dismantled and cleaned and then replaced in the reservation on the concrete structure. The cleaning operation can only be carried out when the pumps are stopped. The current fences would be dismantled and replaced by another structure adapted to the new configuration. The installation of this structure will be as follows:

- Prefabrication of reinforced concrete elements;
- Adjustment of the foundation of the blocks (reinforcement by boulders if necessary);
- Transport of the elements on site;
- Handling and placing blocks by a telescopic crane;
- Assembly of water intakes;
- Installation of the grids;
- Pumping water after cleaning.

3.4.2 Decommission of 1958 and 1985 pumping stations and rehabilitation of 2007/2011 pumping station;

The 1958 and 1985 pumping stations will be decommissioned at the intake and the 2007 and 2011 pumping stations will be rehabilitated/ reinforced in order to reach the necessary flows to satisfy the design capacity of the different files of Dunga WTP.

3.4.3 Modification of the treatment process to deal with Cyanobacteria blooms

As for all shallow lakes, the Winam Gulf (where Dunga intake is located) is vulnerable to pollutants due to its relatively low volume of water compared to its surface. Cyanobacterial blooms have been reported in the Winam Gulf. As the species of cyanobacteria producing microcystis is able to bloom in much contrasted ecosystems, microcystis seems to have been the dominant toxin found in recent years. Removal of microcystins will involve the injection of Powdered Activated Carbon. This will result in the drop in microcystins concentrations below the minimum WHO Guidelines values of 1 µg/l if the concentration in the Lake is below 10µg/l. In any case the addition of PAC in the treatment process would much improve the quality of the water.

3.4.4 Sludge Collection and Treatment

The current situation does not allow for a proper sludge collection system from the decantation tanks. As a consequence, when the tanks are emptied, the sludge chamber overflows and the WTP compound is partially flooded. For a proper operation of the WTP, the sludge collection system needs to be refurbished and sludge treatment should be implemented. Implementing sludge treatment requires a large surface, seemingly not available on the existing site. Land acquisition would therefore be necessary.

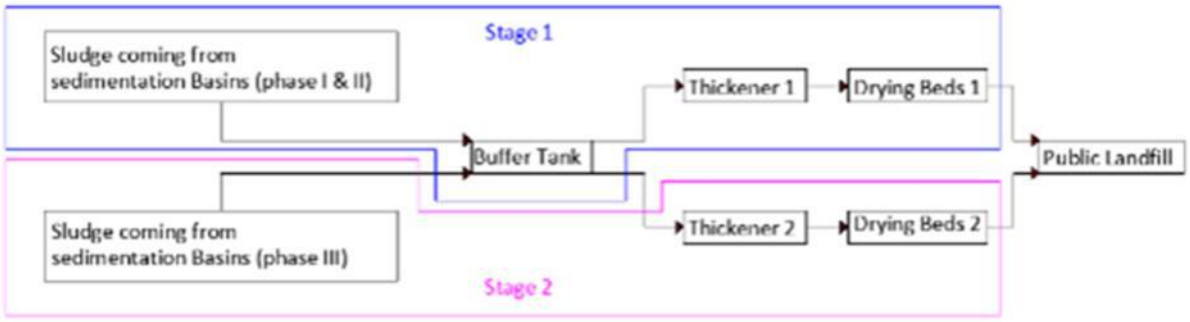
3.4.4.1 Refurbishment of the sedimentation tanks

Due to the significant length of the tanks (more than 40m), the drainage system seems to be inappropriate to collect the sludge over the whole length. Currently, the operator is emptying the tanks weekly to desludge them but this manages only to collect a small part of the sludge. Rehabilitation works will require installation of drainage pipes through the existing lateral walls of the decantation tanks and ensure watertight sealing. The sedimentation tanks refurbishment works shall include the addition of improved access through caged ladders in order to enable the operator to clean the tanks thoroughly. This cleaning operation shall be implemented through mobile high pressure jet washers on a regular basis. It would prevent pipes and equipment (pipes, pumps, scrapper etc.) from clogging and corrosion.

3.4.4.2 Conceptual Design

The recommended system for Dunga sludge treatment would be composed of a buffer tank ; a thickener ; and drying beds. The following figure presents the conceptual design of the sludge treatment solution proposed :

Figure 3.4: Conceptual design diagram



3.4.4.3 Sizing of the Sludge Treatment Lines

3.4.4.3.1 Buffer Tank

A buffer tank is necessary upstream of the sludge treatment system in order to collect and homogenize the effluent collected from the water treatment steps. The buffer tank is sized for the total design capacity of the WTP (Stages 1 and 2) since it would not be economical to split the volume into two tanks. The storage volume of the buffer tank shall be 100 m3. In order to allow homogenization of the sludge, it shall be equipped with a submerged stirrer. The sludge will be pumped to the thickener by 1+1 pumps (including one in standby) with a duty flow of 30 m3/ h each. For each stage, one tank of 320 m³ shall be installed. Sedimentation will be facilitated by injection of a polymer. The thickened sludge will be pumped to the drying stage through one circulation pump of 50 m³/ hr per stage.

3.4.4.3.2 *Drying Beds*

The drying step is the most space-consuming step of the sludge treatment system. Concrete drying beds are preferred in order to optimize footprint, operation and maintenance. Drying beds make it possible to obtain high dryness feature, by simple filtration under very low pressure and favourable weather conditions. This treatment process requires at least two structures, in order to alternate the filling and the drying stages. A total of 15 drying beds of 300 m² each are necessary for the two stages: 8 for stage 1 and 7 for stage 2.

3.5 LAND USE AND PHASING

Land availability is a major constraint for the project. It has therefore been proposed to implement the sludge treatment in two stages in order to provide more leeway to the Client. Based on the available satellite imagery, some land seems to be available east of the existing WTP compound. The conceptual layout proposes to acquire the minimum land surfaces of Stage 1: 3,900 m²; and Stage 2: (additional) 3,300 m².

3.6 CONCEPTUAL LAYOUTS AND PROFILES

The conceptual layouts of Dunga WTP's sludge treatment system is presented in the figure below.

Figure 3.5: Conceptual layout of Dunga WTP's sludge treatment system – Layout

3.7 PROJECT ACTIVITIES LIKELY TO LEAD TO SOCIAL AND ENVIRONMENTAL IMPACTS

3.7.1 Site Clearance

Site clearance will be at the proposed site for construction of sludge drying beds. This shall involve preparation of the site by the contractor by carrying out general clearance of the ground and by removing trees and other vegetation to permit the proper execution of the Works and shall include the clearance of all trees, stumps, bushes and other vegetation and the grubbing out of all roots and the removal of all boulders between 0.01 and 0.2m3 volume and dispose of as directed by the Resident Engineer.

3.7.2 Topsoil Removal

This is the stripping of top soil by the contractor to a depth as shown in the drawings or as specified in the bill of quantities. This shall be done after establishing surface levels of the ground by the engineering team.

3.7.3 Demolition works

This will involve dismantling of any buildings or other structures especially at the Raw Water Intake and stacking the recovered materials pending disposal.

3.7.4 Excavation works

Excavation shall involve digging of trenches for pipe laying. Excavations shall also be done for structures and fill foundations. Excavation works may be associated with damage to structures, services or other properties caused by movement of machinery.

3.7.5 Disposal of Excavated Material

Material obtained from excavations which are not suitable for use in the works will be disposed of in tips provided by the contractor and approved by the Engineer. Measures shall however been put in place to ensure that excess materials which may be surplus to the total requirements of the Works are used in rehabilitation of excavated areas as directed by the Engineer.

3.7.6 Backfilling works

All backfilling of excavations are thoroughly compacted in layers not exceeding 150mm compacted thickness and by means which will not damage the works. Backfilling of excavations for reinforced concrete structures will be done with suitable materials approved by the Engineer. The initial backfill in contact with pipes is selected material and shall not contain large stones, rocks, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes.

3.7.7 Compaction

Compaction shall involve pressing of restored areas using appropriate machinery to restore them to pre-project conditions. Utmost care shall be taken to ensure that no damage occurs to the works and compaction methods applied are those that are approved by the Engineer and ensure that excessive loads are not placed on pipes or structures upon or around which the backfill is being placed.

3.7.8 Surface Reinstatement and Restoration

This shall involve reinstatement by the contractor of all surfaces of roads, fields, paths, gardens, verges etc., whether public or private which are affected by the Works. The sites shall be reinstated temporarily by the Contractor in the first instance and in due course when the ground has consolidated fully, the surfaces shall be permanently reinstated. The temporary reinstatement and maintenance of all surfaces of roads, tracks, paths and any other surfaces which have been affected by the operations of the Contractor are his sole liability and will be carried out to the satisfaction of the Engineer and of the responsible authority and owner. Temporary reinstatements will be carried out immediately the trenches are refilled.

3.7.9 Cost estimates for Dunga raw water intake and WTP

The cost estimates for the Dunga raw water intake and WTP are presented in the table below:

Table 3.1: Dunga intake and WTP – Cost estimates

No	Description	Total cost Euros
1	Dunga raw water intake works	609,050
2	Dunga WTP electromechanical and small civil works	2,272,215
3	Dunga WTP process works, including tanks and pumps for PAC injection, sand for the rapid sand filters, etc.	180,000
4	Dunga sludge treatment works	2,954,500
5	Total	6,015,765
6	Contingencies - 15%	902,365
7	Total with contingencies	6,918,130

4. Baseline Information

4.1 Site Location and Description

The proposed project area is located within Kisumu City of Kisumu County. The Raw Water Intake is located along Latitude 0o7'34.5" S and Longitude 034o44'29.9" E at an elevation of 1110masl while the Water Treatment Plant is located along Latitude 0o7'17.4" S and Longitude 034o44'46.1" E at an elevation of 1131masl. The proposed sludge drying beds are located along Latitude 0o7'18.4" S and Longitude 034o44'48.1" E at an elevation of 1130masl. The project area is dominated by various land uses including residential, commercial and institutional land uses. The vegetation structure found within the project area consists of both natural and planted trees and project area neighbours a wetland. The main source of energy within the proposed project area is electricity from the national grid. Other sources of energy include diesel generators within business premises, kerosene, charcoal and firewood. Water within the area is obtained from pipe system of Kisumu Water and Sanitation Company, boreholes and shallow wells while sanitation facilities within the project area include KIWASCO sewerage system and pit latrines. Various waste management methods have been adopted by residents of the project area and these include use of private waste handlers, burning and composting. Most roads within the project area are done to bitumen standards.

4.2 Physical and Topographic Features

Kisumu County lies in a down warped part of large lowland surrounding the Winam Gulf, at the tip of which is Kisumu Town. The county can be divided into 3 topographical zones namely: the Kano Plains, the upland area of Nyabondo Plateau and the midland areas of Maseno. The major physical features in the county are the overhanging huge granite rocks at Kisian and the legendary Kit Mikayi in Kisumu West Sub- County, the Lake Victoria, which is the second largest fresh water lake in the world, the geographically famous rice-growing Kano Plains, and lake islands (e.g., Ndere National Park which are major tourist attraction). There are three major rivers flowing into the Winam Gulf namely: the Nyando, Kibos and Sondu. The rivers are heavily silted, resulting in the extensive formation of lakeside swamps. The county has a long shoreline along Lake Victoria. This shoreline is 90 km long and has more than 17 beaches all of which are fish landing bays. Within Kisumu City, the shores have been used to put up beautiful tourist hotels like Kiboko Bay, the Yatch Club and Tilapia Beach Resort.

4.3 Ecological Conditions

The soils are dominated by lake sediments, commonly sand and clay soils. In Kano Plains the soils are dark brown and grey, poorly drained and are generally very deep and firm. In the western part of Kano Plains are dark cotton soils commonly associated with the swamps. These types constitute more than 70 per cent of all soil types found in Kisumu County. These soils are suitable for brick making and sand harvesting especially at Maseno and Nyakach. The main cash crops in the county are sugarcane, rice and cotton. Sugarcane is predominantly grown at lower midlands which are common in Maseno, Muhoroni and Miwani while cotton is grown in Kadibo and Nyando.

4.4 CLIMATIC CONDITIONS

The mean annual rainfall varies with altitude and proximity to the highlands along the Nandi Escarpment and Tinderet. The area has two rainy seasons, with the long rains occurring in March and May while the short rains occur in September to November. During the short rains the average annual rainfall ranges between 450mm and 600mm. Rainfall data indicates that the county largely receives substantial rainfall. Maseno has a mean annual rainfall of 1,630mm, Kisumu 1,280 mm, Ahero 1,260 mm, Kibos 1,290 mm, Muhoroni 1,525 mm, and Koru 1,103 mm. The lowland area which forms a trough of low rainfall receives a mean annual rainfall of between 1,000mm and 1,800mm. Although there is no entirely dry month, the peak generally falls between March and May, with a secondary peak in September to November. The mean annual maximum temperature ranges 25oC to 35oC and the mean annual minimum temperature ranges 9oC to 18oC. The altitude in the county varies from 1,144 metres above the sea level on the plains to 1,525 metres above sea level in the Maseno and Lower Nyakach areas. This greatly influences temperatures and rainfall in the county.

4.5 DEMOGRAPHIC FEATURES

4.5.1 Population Census

The 1999 census showed that the population of Kisumu was approximately 280,966. Between 1989 and 1999 censuses the population growth rate of Kisumu was 4.6%. However, from 1999 onwards, the Central Bureau of Statistics (CBS) projects a rate of 2.6% for Kisumu City, as shown in the table below.

Table 4.1: Population Census Summary for Kisumu City

Year	Population	Households	Growth Rate	No. of Wards
1969	97,685	-	3.45%	14
1979	138,296	-	3.5%	14
1989	217,788	-	4.6%	14
1999	280,966	71,853	2.6%	14

Source Seureca/CAS Feasibility Study Report 2006

4.5.2 Population Projection

Based on the above-mentioned growth rate, Kisumu's population is projected to reach 1327,746 by 2011, 533,000 by 2025, and 622,618 by 2031. The Feasibility Study (Seureca I CAS Consultants 2005) applied a growth rate of 3.2% between years 1999 to 2025, giving an ultimate population of 637,318. MP/OOP considers that projection based on CBS's growth rate to be accurate. The following table gives the population projections breakdown per each sub location or Ward in the City.

Table 4.2: Population Projection

Sub Location	Category	Population 1999	Area in Ha	2006	2011	2020	2031
Kibuye (Migosi, Nyawita	Urban	48,165	685	56,184	63,878	80,478	106,733
Milimani (N & S)	Urban	19,741	514	23,048	26,181	32,985	43,746
Kanyakwar	Urban	8,576	1014	10,004	11,374	14,330	19,004
Nyalenda (A & B)	Peri-Urban	49,375	582	57,596	65,483	82,500	109,415
Manyatta (A & B)	Peri-Urban	62,937	624	73,416	83,469	105,161	139,468
Wathorego	Peri-Urban	14,394	1035	16,791	19,090	24,051	31,897
Korando	Peri-Urban	14,950	1754	17,439	19,827	24,980	33,129

Kogony	Peri-Urban	13,960	1480	16,284	18,514	23,326	30,935
Kasule	Rural	10,701	1871	12,483	14,192	17,880	23,713
Chiga	Rural	7,109	2083	8,293	9,428	11,878	15,753
Nyalunya	Rural	8,686	2035	10,132	11,520	14,513	19,248
Kadero	Rural	5,304	569	6,187	7,034	8,862	11,754
Okok Got Nyabondo	Rural	6,760	843	7,886	8,965	11,295	14,980
Konya	Rural	10,308	1158	12,024	13,671	17,224	22,842
Total		**280,966**	**16,247**	**327,746**	**372,627**	**469,463**	**622,618**

The Seureca I CAS feasibility study determined that the water supply system could not be feasibly be extended to serve the entirety of Kisumu City and its outlying areas. Therefore, the population figures used in design are not those of Kisumu City as a whole, but only for the areas intended to be covered by the LTAP, as shown in the following table.

Table 4.3: Population Projection in areas to be served by LTAP Works

Sub Location	Category	Population 1999	Area in Ha	2006	2011	2020	2031
Kibuye (Migosi, Nyawita	Urban	48,165	685	56,184	63,878	80,478	106,733
Milimani (N & S)	Urban	19,741	514	23,048	26,181	32,985	43,746
Kanyakwar	Urban	8,576	1014	10,004	11,374	14,330	19,004
Nyalenda (A & B)	Peri-Urban	49,375	582	57,596	65,483	82,500	109,415
Manyatta (A & B)	Peri-Urban	62,937	624	73,416	83,469	105,161	139,468
Wathorego	Peri-Urban	14,394	1035	16,791	19,090	24,051	31,897
Korando	Peri-Urban	14,950	1754	17,439	19,827	24,980	33,129
Kogony	Peri-Urban	13,960	1480	16,284	18,514	23,326	30,935
Kasule	Rural	10,701	1871	12,483	14,192	17,880	23,713
Chiga	Rural	7,109	2083	8,293	9,428	11,878	15,753
Total		249,908	11,642	291,518	331,436	417,569	553,793

4.5.3 Population Density

The mean population density in Kisumu City is projected to vary from 2,017 per km2 to 3,735 per km2 from the year 2006 to the year 2031. The sub locations of Kibuye. Milimani, Nyalenda and Manyatta will have population densities varying from 8,202 to 11,765 persons per km2 in 2006, to 15,187 to 21,7984 persons per km2 in 2031. The particulars of population density for Kisumu City and its sub locations are given in the Table below:

Table 4.4: Population Density projections for Kisumu City

Sub Location	2006	2011	2020	2031
Kibuye (Migosi, Nyawita)	8,202	9,325	11,749	15,187
Milimani (N & S)	4,408	5,094	6,417	8,295
Kanyakwar	987	1,112	1,413	1,827
Nyalenda (A &B)	9,896	11,251	14,175	18,323
Manyatta (A & B)	11,765	13,376	16,853	21,784
Watorego	1,622	1,844	2,324	3,004
Korand	994	1,130	1,424	1,841
Kogony	1,100	1,251	1,576	2,037
Kasule	667	750	956	1,235
Chiga	398	453	570	737
Nyalunya	498	566	713	922
Kadero	1,087	1,236	1,557	2.013
Okok, Got	935	1,063	1,340	1,732

Nyabondo				
Konya	1,038	1,181	1,487	1,923

4.6 SOILS

The soils in Kisumu County are dominated by the former lake sediments, commonly sands and clay soils. In Kano plains, the soils are poorly drained and are generally very deep and firm. They are dark brown and grey in colour. In the western part of the Kano plains are the dark cotton soils commonly associated with swamps. On the slightly elevated grounds and piedmont plains are clay soils, which are usually of moderate fertility. On the uplands are sandy soils, which are derived from intermediate igneous rocks. These soils are also imperfectly drained and reasonably deep. The North western part of Kisumu has ferrasols and acrisols which have developed from the granites of rocky south Kakamega uplands. These soils are of low fertility and have rock bases not more than 80cm from the surface. On the fringes of the Winam Gulf and Lake Victoria beach ridges are soils of varying fertility, most of which are susceptible to water logging. The black cotton soil is found mainly in the plains while the upper zones are marked with residuals of brown volcanic soils. In some areas, the soils are rocky giving rise to sandy soils.

4.7 BIODIVERSITY

The project area is endowed with flora, fauna and microbes. The area's wild animals are classified as grassland community. In recent years, man has caused the destruction of the grassland cover, has killed vast numbers of wild animals, and in so doing has opened up large areas for domestic animals. In this way, the number of wild herds has been reduced and they now tend to be confined to certain protected areas. The district has two national parks, viz, the Impala Park and Ndere Island. Ndere Island is a gazetted game park and is the home of Sitatunga, Impalas and Monkeys. The Impala Park in Kisumu Municipality has an orphanage and a sanctuary for leopards, hyenas, dik diks, baboons, monkeys and tortoises in their caged section, while impalas, crocodiles, monitor lizards, hippos, monkeys and pythons roam freely inside the park. The district also has a national museum, which also houses the snake park, where live cobras, black mambas, green mambas, puff udders, pythons and crocodiles are caged for viewing. The grass land also supports myriads of seed eating birds including pests such as grain-eating weaverbirds. Many species of rats, mice and numerous other rodents are also found in this area. Inside the lake, Hippopotamus (Hippopotamus amphihibius) are normally found in herds. Their dung fertilizes the habitat thus providing food for certain water plants such as algae on which the lake fish feeds. Crocodiles (Crocodylus niloticus) are found in and by the shores of the lake, as are a great variety of fish stock, some of which have been introduced from outside the area. The two native Tilapia species are Tilapia escutenta and Tilapia variabilis. The introduced species are Tilapia nilotica, Tilapia zilli and Tilapia leocostica. Another important introduced species is the Nile perch (Lates nilotica) which is predatory. Other examples of predatory fish in L. Victoria include Lung fish (Protopterus annecteus) Catfish (Clarius mozambicus), Bagrus and Haplochromis. The lake swamp is also known to be an excellent habitat for the python.

4.8 ENERGY RESOURCES

The main source of energy for cooking in Kisumu County is firewood which accounts for 60 per cent of all energy sources. Charcoal comes second at 17.1 per cent followed by paraffin at 6.9 per cent, gas (LPG) accounts for 2.5 per cent. For lighting, paraffin is the most commonly used source of energy in the county accounting for 79.3 per cent of all energy sources followed by electricity at 18.3 per cent. Electricity as a source of energy is becoming more important in the county with increase in coverage over the last few years especially through the Rural Electrification Programme. Currently, a number of trading centres and secondary schools in the county have been connected to the national grid. An increased number of households have also been connected to the national grid. With the implementation of the laptop project, it is expected that the remaining centres and primary schools will be electrified.

4.9 LAND USE AND TENURE

4.9.1 Industrial Land Use

The current major land uses in Kisumu are for industrial, commercial and residential purposes. The industrial area is situated close to the lake and runs parallel to the lakeshore. The area is served mainly by the railway and acts as the terminus of the two railway lines that connect Kisumu with the rest of Kenya. The industrial area is separated from other land uses by Makasembo road and extends towards the airport in the northwest. In 1969, the industrial zone covered a mere 6.5% of all land uses in Kisumu (Kenya Government 2004) but it has since expanded in two directions; along the road to Maseno in the northwest and along the road to Chemelil in the north east.

4.9.2 Commercial Land Use

The Central Business District (or CBD) is main area of commercially-used land in town. The northern section of the CBD predominantly consists of the central and local government administrative offices, whereas the central portion consists of modern offices, department stores and branches of Nairobi-based companies.

4.9.3 Residential Land Use

The residential zone covers the greatest portion of urban land in Kisumu. Distinct subdivisions of residential areas related to the historical growth of the town can also be noticed. Kisumu's residential land use falls into three main categories namely:

- The high-class residential areas including Milimani, Robert Ouko, Tom Mboya and Okore in the northern suburbs of the town;
- Low and middle income/ public housing areas including the municipal houses, railway houses, Kenya post, Kenya Power etc. most of which dominate the eastern side of the town; and
- The peri-urban, slum settlements and the rural extended boundary areas.

Surrounding the central part of the town is a belt of unplanned slum and informal settlements that has developed to form a semi-circle around the old town. These include Nyalenda, Manyatta, Bandani, Kibos, Nyamasaria, Pandpieri, Migosi and Obunga. Manyatta Arab and Kaloleni alone are located within the CBD. The average plot sizes in the neighbourhoods and estates are quarter acres, which are normally freeholds with titles issued. But in some estates, the residents have an average plot size of 0.8 acres and on a freehold ownership with no titles issued.

4.10 LAND TENURE

Land tenure in Kisumu Municipality now tends to be either on a freehold and leasehold basis. The earlier inhabitants of the area - the Luo tribe - controlled the distribution of land in the peri-urban areas of Kisumu. Traditionally, the Luo considered land to be the property of the community, usually the clan, but each member of the clan would be allocated a parcel of land to farm and thereby feed his family. Grazing land and watering places were common and everyone was obliged to provide access to such common land. Subdivision of the pieces of land continued with inheritance from uncles and brothers. Because of this culture of bequeathing land on the sons, further subdivisions of the small parcels of land took place until the size of the land made it uneconomical for most agricultural purposes, although a number of homes continued to breed livestock. In Kisumu 'slum belt', land has gone through the process of adjudication and a large portion has been registered as individual interests on freehold tenure. The principal reason for this is that neither the municipal council nor the central government has been able to acquire any interest on this land due to the cost of compensation that would need to be paid to the dweller. The peri urban area features a number of quality structures that Kisumu Council cannot afford to acquire with a view to gaining full control over their development.

4.11 LAND USE AND LAND TENURES IN VARIOUS AREAS OF KISUMU MUNICIPAL AREA

4.11.1 Nyalenda

Recently there have been rapid transitions in the type land use and tenure in the informal settlements. For instance, in Nyalenda, Nyamasaria and Pandpieri the original inhabitants are selling land to newcomers who are constructing quality residential houses. The original owners tend to stay in typical rural housing surrounded by new developments. Land in Nyalenda 'A' is on freehold tenure. Families tend to hand land down to successive generations and rural traditions such as the burying of the dead within the compounds are maintained. To this extent the area can be characterized a rural settlement caught up in urban expansion. Such cultural practices make it very difficult to bring such parcels into the urban land market, despite its location and proximity to the up market Milimani residential area. Nyalenda 'B' is similar to Nyalenda 'A' but the Nyalenda B has, for a variety of reasons, been able to attract new developers.

4.11.2 Pandpieri

Although Pandpieri began as an extension of Nyalenda, its internal accessibility is slightly better and the density of population and settlement continues to be lower. This can be attributed to its proximity to swamps and the distance from Pandpieri to major areas of economic activity. It also has fewer graves and this makes it more amenable to the land market. On the eastern side of this area lies a large tract of agricultural land that is seasonally flooded. This land is an important component of the community's livelihood and is still owned communally by the native inhabitants of the area.

4.11.3 Obunga and Bandari

In Obunga and Bandani, since the 1970's, ownership of land has begun to move away from the communal system towards individual ownership and the majority of the residents have purchased their land as opposed to inheriting it. Those who have bought land acquire title deeds to their property on a leasehold tenure. These areas have experienced a gradual fragmentation of land as the land use has changed from agricultural to residential and commercial, a trend that has accelerated since 1990. The land is now predominantly commercialized, although a few families still keep livestock. Commercialization of land has become so common that in the absence of proper planning controls, there is virtually no land left for public facilities.

4.11.4 Manyatta

In Manyatta, land ownership has changed steadily from individual ownership by indigenous populations to small plots bought by people from outside the region, who have invested in commercial and residential buildings. The land value in the area has increased steadily over the last two decades. Manyatta Arab and Kaloleni are located on government land with leasehold tenure which has made the re-planning of the area easier to undertake. Tenants occupy the land under Temporary Occupation License terms and are not allowed to construct permanent structures. After recent upgrading programmes and allocation of plots within the slums, a few tenants have since managed to get title deeds.

4.11.5 Suburban fringes

The suburban fringe areas border the existing slum settlements and could potentially degenerate into slum areas if sufficient over-crowding and pressure on existing resources occurred. The zone is currently undergoing rapid subdivision, urbanization and rising densities, without adequate infrastructure and social services. The land tenure in this area is mixed, with a large portion of the land under freehold tenure and a smaller portion under leasehold.

4.11.6 Kanyakwar

In Kanyakwar area, many people have bought land for residential development leading to rapid subdivisions and sale of land. It is important to note that such areas provide the Municipality with the opportunity to acquire land for development projects to provide for the urgent need for community facilities both in the slum areas and to handle the population overspill that suburban areas are facing from the people displaced by redevelopment.

4.12 INDUSTRY

With the implementation of the East African Community protocol, Kisumu aims to become capital of the regional bloc. Lake Victoria contributes a very large part to the economy of the county since it supports the fishing and fish processing industry the county's main economic activity. Opportunities exist in further developing this sector for local and export markets. Agriculture is also a common economic activity with sugar industries like Muhoroni, Chemelil, Kibos and rice irrigation industries employing a good number of residents. There are opportunities for further investment in this sector.

Equator Bottlers recently unveiled a Sh1.5 billion bottling plant; Jumbo Mattress Co has established a factory at Ahero while Foam Mattresses is setting up a plant in the town. Other companies setting up shops within Kisumu Town include Mayfair Holdings and United Millers, which recently completed the United Mall that hosts businesses including Tuskys Supermarket and Fox theatres. The county has a total of 27 manufacturing industries, 16 bakeries, 12 Jua-kali association and 10,500 Jua-kali artisans.

4.13 EMPLOYMENT AND OTHER SOURCES OF INCOME

The wage earners/ self employed people in the county account for 87.5% of the labour force, which are 184,650 people. Employment levels are skewed against female. The employment levels for the males are 89.4% while for the female is 85% relative to their labour force. The county has an active labour force of 211,077 of which 54.78 per cent (115,624) are men and 45.22 per cent (95,453) are women. This is due to the fact that the population of females is relatively lower than the males though not a sufficient factor to explain this disparity. The total unemployment level in the County is estimated at 12.5%. The unemployment levels are higher in women than men, i.e., 15% of females are unemployed compared to 10.6% of males who are unemployed. Youth unemployment in the county is mainly due to lack of startup capital and entrepreneur skills.

4.14 ROAD NETWORK

Kisumu's high-income residential areas and formal public housing areas are well served with road infrastructure. However, poor road networks are a common feature in low-income areas because the council's input in terms of planning and capital outlay is minimal. Municipal rental areas are also characterized by decay in infrastructure. A combination of the council's financial constraints and poor governance among the urban poor has resulted in a tendency to concentrate resources on the wealthier areas of the town. Road reserves, which are primarily intended for the provision of service corridors for sewerage, storm drainage and piped water networks, are almost non-existent in slum areas. This is partially due the fact that the road networks are unplanned and also that the few planned road reserves have now been encroached upon by developers. Obunga and Bandani are an example of this. The roads in these areas are amongst the worst in Kisumu. The roads are generally impassable due to poor drainage, inadequate spacing of houses and widespread sewers. Additionally, the roads are not clearly demarcated and structures have been erected on the road reserves. Handcarts are the main modes of transport to access the main roads. In Bandani, unplanned development is predominant on the fringes parallel to the main tarmac road. The railway line cuts Bandani off from the main road, with only one level crossing that does not link well with the internal paths within the areas.

In accordance with rural planning standards that were current at the time of construction, the access roads in Nyalenda, Nyamasaria and Pandpieri, are only 6m wide. However, in urban areas 6m width is only considered suitable for access roads to single plots. However, the majority of roads in these areas do not adhere to even this standard and are only approximately 4m wide. The ring road is the only access network completed which has led to the increase in land values and a change in use to commercial purposes. The ring road is the only public transport vehicle route in the area, beyond which access to the slum area is on foot or bicycle. All the roads within the slums are narrow tracks which lack drainage. Houses are constructed right up to the road edge on either side, allowing no space for road widening.

Manyatta 'A' and Kaloleni are the only slum settlements with well designed road networks that have been gradually improved to increase accessibility to more that 60% of the area. However, the lower parts of Manyatta lack proper roads similar to other slum areas. The Nairobi Road is the only motorized access to Manyatta 'B'. Walking and bicycles are the main modes of transport in Manyatta 'B' where roads are narrow, muddy; water logged and lack drainage systems and street lighting. Manyatta Arab although located in the town centre, does not have an adequate road system because, like other slum areas, its size and density would require some degree of demolition to take place to provide space for new roads.

The suburban fringe areas of Kisumu such as Kibos, Usoma and Kanyakwar lack infrastructure services and the roads are of a similar condition to those in the slums. The road network is of rural standards, which is unlikely to cope with the increased flow of traffic the new developments will bring. The roads are approximately 6m wide and encroachment on the road reserves is common. This will pose challenges in the provision of infrastructure services, such as storm drainage, street lighting, sewage and water.

4.15 WATER SUPPLY

The water supply system in Kisumu can be categorized into three systems: that provided by KIWASCO, the peri-urban system and the system provided within the informal settlements. The existing water supply facilities provided by KIWASCO are in very poor condition and a large proportion of the population has no access to the service. The coverage of KIWASCO's current water supply network commands 40% - 50% and is mainly concentrated within the built-up urban centre. The combined water supply capacity from the two water treatment systems amounts to 20,000m3/day, which is less that half of the predicted demand of 50,000m3/day (Department of the Environment strategic plan of 04-07). Peri-urban water supply systems consist of small-scale systems, outside the KMC service area, operated by MW&I, CB0s, NGOs, etc. Informal Settlements Systems are a combination of the Municipal System and Peri-urban Systems.

The existing water supply in the low-income areas, including the informal settlements, is inadequate and does not meet the demand. There is no reliable distribution network and piped water is mostly available through water kiosks. Most of the water connections in these areas are illegal, resulting in major financial losses for KIWASCO. Water vendors help in the distribution of the water to the areas away from the water sources.

Shallow wells, springs, boreholes, streams/rivers and Lake Victoria are important alternative water sources. However, most of these sources are of dubious quality and likely to be contaminated due to over-flowing pit latrines, poor wastewater management, and inadequate solid waste and drainage systems. In some of the informal settlements, KIWASCO piped water supply distribution networks are in place, but there is no water supply. In the informal settlements particularly, some sections of the network have been vandalized. Water carriers in the area help in the distribution of the water to the neighbourhoods. The majority of residents in the informal settlements still obtain water from kiosks, shallow wells, streams and rainwater harvesting. The wells in the settlements are in poor condition, some are unprotected and the water supplied is of dubious quality. The infrastructure for the delivery of water services in the informal settlements is either inadequate or non-existent.

The peri-urban areas are also affected by inadequate infrastructure facilities with most residents acquiring water from contaminated sources. Few properties have connections to piped water, and roof catchments are a common method of water collection. Shallow wells, streams and springs also serve a large proportion of the population in these areas.

4.16 SANITATION FACILITIES

The main sanitation facility in Kisumu is the pit latrine. However, in black cotton soil areas, pit latrines are often less than six meters deep and therefore tend to fill up quickly and/or overflow. Ventilated Improved Pit (VIP) latrines are a better alternative than unlined pit latrines because they are less odoriferous, but in 2007, only an estimated 7% of residents used these (LVSWWDA, 2008). There are relatively few public toilets in Kisumu City, most of which are concentrated in informal settlements such as Bandani, Nyamasaria and Obunga. In the city center, there are public toilets in places like the markets, Bus Park and Jomo Kenyatta grounds. The sewerage system in Kisumu can be classified into three wastewater treatment districts (WTD) i.e the Central WTD, which collects wastewater generated in the northwest; the Eastern WTD, collecting wastewater from the southeast; and the Western WTD, which covers the area below the airport.

There are two types of sewer systems in Kisumu City: a conventional sewer system and a lagoon system. However, the 6,800m3 sewer system serves less than 10% of the population, and the two sewer systems do not accommodate most of the generated wastewater (UN-HABITAT, 2008). In addition, frequent sewer bursts and blockages are common, resulting in groundwater contamination, environmental pollution and outbreaks of water-related diseases. The low-lying areas of Manyatta and Nyalenda have no sewer system, as they are lower than the conventional sewer.

Areas with access to the public sewer network include Lumumba, Makasembo, Milimani, Ondiek and Robert Ouko. The capacity of the sewerage infrastructure is 17,800m3/day (if operating at full capacity), far less than what is required (LVSWSB, 2008). The sewers were built more than four decades ago, and there has been no rehabilitation or extension of the sewer system, except for the Kibos Trunk sewers, which were built in 1980 (LVSWSB, 2008). Upgrading and expanding the sewerage infrastructure is therefore urgently required.

4.17 SOLID WASTE

In 2001 it was estimated that only 20 percent of the 400 tons of solid waste generated each day in Kisumu City was collected. By 2008, the daily generation of household waste was estimated to be 437 tons. Fortunately, about 63% of the waste generated in Kisumu is organic; hence there is enormous potential for composting. The city authority (MCK) only has four trucks (two 2-ton trucks, an old 7-ton compactor truck and an old tractor with a trailer) for collecting waste. These vehicles are in poor condition and often break down. As a result, many households, particularly in the peri-urban areas, have no access to public services and are unable to access private waste collection due to fees levied. They therefore resort to burning or burying their waste. Some common dumping grounds have developed on open lands within densely populated neighborhoods. The poor management of solid waste blocks sewers and drainage systems; provides a breeding ground for disease vectors and contributes to the generation of leachates, which pollute the ground water and further contribute to waste related diseases. The city can significantly reduce the waste taken to the existing dumpsite - located near Moi stadium - by composting and recycling, methods not widely practiced in Kisumu, even though adopting these measures would also alleviate environmental pollution and provide informal employment through the resale of the recyclables.

4.18 CIVIL SOCIETIES OPERATING IN THE INFORMAL SETTLEMENTS

A number of civil societies, non-governmental organisations (NGOs) and microfinance organisations operate programs in the informal settlements. They include World Vision, Sustainable Aid in Africa (SANA), KADET, WEDCO, KWFT and the Undugu Society. In addition, a number of local Community Based Organizations (CBOs) also exist within these areas. The programs undertaken by these organisations target diverse areas including improvement of water and sanitation conditions, poverty alleviation and addressing the social and economic impacts of HIV/AIDS. Several NGOs and CBOs operate in Manyatta with programmes focusing on home-based care for HIV/AIDS victims, orphans and affected families with free Voluntary Counseling and Testing (VCT) schemes. A number of organisations including KADET, WEDCO, KWFT and the Undugu Society, offer low interest credit to the residents in order to enable them to invest in and develop income-generating schemes.

The NGOs currently involved in water and sanitation programs in the informal settlements include SANA, World Vision and Undugu Society. Of these, only SANA has a fully comprehensive hygiene promotion focus. SANA uses the PHAST (Participatory Hygiene and Sanitation Transformation) approach, working with CBO partners, and using the Child-to-Child (CTC) approach in hygiene promotion activities in community schools in Manyatta B. SANA has undertaken water and sanitation projects including hygiene education in Bandani and Manyatta "B". World Vision and the Undugu Society use organised community groups as partners in the implementation of their programs. World Vision, whose main programmes are child-focused, operates particularly in Obunga and Bandani and projects include environmental cleanup days in conjunction with the community of Manyatta "A". The organisation is also supporting plans for improving water supply and sewerage system in Manyatta "A", in collaboration with KIWASCO and Ministry of Water and Irrigation.

5. Policy, Legal and Institutional Framework

5.1 Introduction

Law is a system of rules that are created and enforced through social or governmental institutions to regulate behaviour while a policy is a deliberate system of principles to guide decisions and achieve rational outcomes. A policy is a statement of intent, and is implemented as a procedure or protocol. Law is a system that regulates and ensures that individuals or a community adhere to the will of the state. The law shapes politics, economics, history and society in various ways and serves as a mediator of relations between people. Policies are generally adopted by a governance body within an organization.

5.2 Laws governing Environmental Management in Kenya

The need to take good care of environment is of essence for the survival of human beings. The law has intervened and ensures that human beings are considerate, cautious and careful in their dealings with the environment. Kenyan constitution begins with acknowledging the need for cautionary dealings with the environment by a provision in its preamble that," We the people of Kenya are RESPECTFUL of the environment, which is our heritage, and determined to sustain it for the benefit of future generations" The wording of the constitution in its preamble clearly suggests respect to sustainable development.

5.3 Policy, Legal and Administrative Framework applicable to the proposed project

The review of policy, legal and administrative provisions has been carried out to establish the frameworks within which the significance of the various impacts expected to emanate from proposed project activities can be evaluated. A lot of emphasis has been placed on those frameworks and protocols that have a direct bearing on water and sanitation sector. Legal and regulatory frameworks applicable to the proposed project have been categorised into various sub headings. These include constitution of Kenya and relevant national policies, Kenyan laws and regulations and international agreements and conventions. The regulatory framework considered includes institutions within the water sector and the National Environment Management Authority (NEMA). World Bank Guidelines relevant to the proposed project have also been reviewed. These rules and regulations have formed the basis for the determination of the significance of the various impacts associated with the proposed project. The Tables below give summary of policy, legal and administrative frameworks reviewed and their relevance to the proposed project.

5.4 Constitution of Kenya 2010 and The Relevant National Policies

Table 5.1: Relevant National Policies

National Policy	Provisions	Relevance to the project
The constitution of Kenya 2010	The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the proponent in respect to protection of	The proponent shall ensure that establishment and operations of the water supply and treatment works do not infringe on the right to a clean and healthy environment for all. The proponent must ensure that the development is carried out in an ecologically, economically and

	the environment and enforcement of environmental rights.	socially sustainable manner. More importantly, the proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.
Kenya Vision 2030	The Kenya Vision 2030 provides the national development blueprint for the period 2008 to 2030 emanating from the Economic Recovery Strategy for Wealth and Employment Creation. The Visions objective is to transform the Country into a middle-income economy with a consistent annual growth of 10% by year 2030. The Vision outlines the 2030 goal for urban areas as to achieve a "well housed population living in an environmentally-secure urban development" The vision envisages to achieve this by bringing basic infrastructure and services including roads, street lights, water and sanitation facilities, storm water drains, footpaths and others to the people. In achieving these, the vision emphasizes on the need promoting environmental conservation to better support the economic pillar.	The proposed project intends to improve water supply and service delivery in Kisumu City through construction of water supply and sanitation infrastructure. This initiative is part of the process in achieving the goals of Vision 2030 for Kisumu residents. The proponent should also endeavor to protect the environment in supporting the economic pillar of the vision
National Policy on Water Resources Management and Development (1999)	The Sessional paper No. 1 of 1999 was established with the objective of preserving, conserving and protecting available water resources and to ensure that water is allocated in a sustainable, rational and economic way. The policy further desires to supply water of good quality and in sufficient quantities that meets the various water needs while ensuring safe disposal of waste water and environmental protection. To achieve these goals, water supply through increased household connections and developing other resources and improved sanitation is required	While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors of socio-economic progress, it recognizes the by-products of this process as wastewater. The proposed project is geared towards providing sufficient and good quality water supply to Kisumu city residents. As an ongoing process, the proponent will put in place strategies and plans for waste water management.
The National Environmental Action Plan (NEAP).	The NEAP was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and conservation of natural resources are an integral part of societal decision making. The NEAP also establishes the process of identifying environmental problems and issues, raising environmental awareness, building national consensus, defining	The proposed project will interact with the various elements and components of the physical, social and economic environments in ways that could lead to negative impacts. A multi-sectoral approach is desired in identifying and solving environmental problems. All partners and stakeholders should be continuously engaged in identifying and solving environmental problems

	policies, legislation and institutional needs and planning environmental projects.	
National Environment Policy, 2013	The Policy sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources. The policy further acknowledges that natural resources are under immense pressure from human activities particularly for critical ecosystems including forest, grasslands and arid and semi-arid lands. The policy seeks to develop an integrated approach to environmental management, strengthening the legal and institutional framework for effective coordination and promoting environmental management tools	This EIA study has developed an environmental and social management and monitoring plan to mitigate the impacts that may result during the construction and operation phases of the project. This tool is aimed at promoting coordination of environmental management of the project such that sensitive ecosystems are not destabilized by project activities
The National Land Policy, 2009	In chapter 4 of the land policy under Environmental Management Principles, the policy provides actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution. The policy also recommends for appropriate waste management systems and procedures, including waste and waste water treatment, reuse and recycling. The policy further advocates for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has been indicated as key in the monitoring and protection of the environment. The policy also advocates for the implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage industries to use cleaner production technologies.	The proposed project will result in the generation of sludge from the water treatment process. Sludge management will be carried out in a way that complies with provisions of this policy. The project proponent engaged the stakeholders during the ESIA process and will continue to engage them throughout the construction and operation phases of the project. Any act of pollution to the environment will be remedied by the polluter in compliance with the provisions of this policy.

5.5 KENYAN LAWS AND REGULATIONS

Table 5.2: Relevant Legal Framework

Legal Framework	Provisions	Relevance to the project
The Water Act of 2016 Cap 372 laws of Kenya	This is an Act of Parliament to provide for the regulation, management and development of water resources; water and sewerage services; and for other connected purposes. With regard to the	The Water Act 2016 provides for the management, conservation, use and control of water resources and for the acquisition and regulation of

	regulation and management of water resources, the Act establishes Water Resources Authority that serves as the agent of the national government to regulate the management and use of water resources. The Act provides for regulation of water rights and works and provides for water permit in Section 36. The Act further provides for right to clean water and establishes Water Works Development Agencies and stipulates their power and functions in Section 68.	rights to use water, to provide for the regulation and management of water supply and sewerage services. Pollution of the neighbouring Lake victoria must be avoided through implementation of appropriate control measures.
Environmental Management and Coordination Act (EMCA) 1999	The Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.	Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit an EIA report to NEMA for consideration for decision making. This report is prepared to comply with the provisions of this section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act and these must be complied with by the Project Proponent.
The Environmental Management and Co-ordination (Waste Management) Regulations, 2006	The Regulations focus on management of solid waste, industrial waste, hazardous waste, pesticides and toxic substances and radioactive substances and are aimed at addressing the impact of pollution from solid waste on the environment which becomes important sources of disease-causing pathogens	In compliance with these Regulations, the proponent will ensure proper waste management throughout the project cycle and shall procure the services of a NEMA licensed contractor to manage solid wastes generated in the course of project construction and operation processes.
Environmental (Impact Assessment and Audit) Regulations 2003	These Regulations guide the preparation of EIAs including how experts should conduct the EIA process and guidelines and standards to be met by the reports. The Regulations were reviewed in 2016 to align them to the Kenya Constitution 2010. They were also recently amended (2019) to address challenges that have been reported since they were gazetted.	The process of carrying out ESIA shall comply with stipulations in the Regulations and EIA Experts must be those who meet minimum conditions stated in the Regulations
Noise and Excessive Vibrations Pollution Control Regulations 2009	The regulations seek to control noise and vibration pollution generated from various sources. Regulation 13 prohibits any person from carrying out construction activities at night, if such activities are likely to generate noise above the levels set under second schedule of these regulations. Regulation 14(3) requires that any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do	Contractors will operate on the basis of maximum permissible noise levels contained in the First Schedule of the Regulations. Provisions relating to licensing procedures for various site activities shall also be complied with throughout construction and operation phases of the project.

	not exceed 0.5 centimetres per second beyond any source property boundary or 30 meters from any moving source.	
Water quality Regulations 2006	These Regulations address the challenges of pollution of water resources and conservation. It consists of VI parts and eleven schedules dealing with protection of sources of water for domestic use to miscellaneous provisions.	The proponent and contractor will implement measures to prevent water pollution from construction activities and effluent discharge at operational phase. Periodic water quality monitoring will be carried out throughout project operation phase
Occupational Safety and Health Act 2007	This Act provides for the general duties of occupiers of work places. In Part II Section 6(1), it states that every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace. Part VI on health general provisions has provisions for cleanliness, overcrowding, ventilation, lighting and drainage of floors. On machinery safety, the Act provides for safe use of plant, machinery and equipment and examination and testing of plants. The Act also has permits to work provisions, protective clothing and appliances and offences and general penalty	The contractor will continuously improve the safety and health standards at the construction site making safety concern everyone's responsibility. Emergency response plan, warning signs, machinery safety and construction safety provisions of the Act which are aimed at managing occupational accidents, incidents and injuries at the work place will be put in place. All requisite trainings, approval and permits including Workplace Registration Certificate shall be procured by the proponent/ contractor
The Malaria Prevention Act (CAP 246)	This Act provides measures to curb the breeding of mosquitoes on development sites. Measures proposed in the Act to control the breeding of the vector include: maintenance of free drainage channels, removal of stagnant water from any land around an area to prevent larvae breeding, removal of waste and broken bottles among other measures.	The contractor will backfill and drain all open pits that may act as water pools to discourage breeding of mosquitoes which are malaria disease vectors and may in return spread malaria in the project area.
The County Government Act, 2012	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 well-being of the general public.	The Act gives right to access private property at all times by the County Government officers and servants for inspection purposes and the proponent must comply with this both during construction and operation phases of the project.
The Employment Act of 2007	The Act covers such critical issues including discrimination in employment, sex harassment at work, contract of service protection of wages, rights and duties in employment such as hours of work and termination of service, protection of children and dispute resolution procedures. The Act therefore declares and defines the	The project proponent is expected to comply with provisions of this Act as they relate to terms of employment and working hours. Equal opportunity shall be given to all communities around the project area so as to improve the socio-economic status of

	fundamental rights of employees, to provide basic conditions of employment of employees and to regulate employment of children. The Act prohibits all forms of child labour.	the area around the proposed project. No minor shall be employed at any workplace throughout project construction period.
Children Act Cap 141	This is an Act of Parliament to make provision for parental responsibility, fostering, adoption, custody, maintenance, guardianship, care and protection of children; to make provision for the administration of children's institutions; to give effect to the principles of the Convention on the Rights of the Child and the African Charter on the Rights and Welfare of the Child and for connected purposes. That Act provides that in all actions concerning children, whether undertaken by public or private social welfare institutions, courts of law, administrative authorities or legislative bodies, the best interests of the child shall be a primary consideration. The Act also protects children from harmful cultural rites, sexual exploitation and drugs.	Protection of child rights as envisioned in this Act shall be complied with at all times by the project proponent and other stakeholders in the construction process. Sexual abuse, exploitation and harassment of children by construction workers shall be dealt with decisively by the All stakeholders in the construction process. Employment of persons below the age of 18 years shall not be condoned.
Sexual Offences Act 2006	This is an Act of Parliament to make provision about sexual offences, their definition, prevention and the protection of all persons from harm from unlawful sexual acts, and for connected purposes. The Act has provisions for attempted rape, sexual assault, defilement and attempted defilement. The Act also has provisions on sexual offences relating to position of authority and persons in position of trust	Sexual harassment of construction workers and the local community shall be avoided at all times throughout project operation period. Those in position of authority especially persons in charge of hiring labour shall not use those positions to exploit job seekers.
Traffic Act (Cap 403)	The Act prohibits obstruction of traffic, either by persons or facilities constructed in such a way as to interfere with the flow of traffic on roads or road reserves. The law also regulates the quality of exhaust emissions from such mobile vehicles.	Vehicles and machinery to be used at the project must comply with provisions of Traffic Act as it relates to the use of public roads
The Wildlife Conservation and Management Act, 2013	This is an Act of Parliament to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. The Act is the main legal force behind the management and administration of national parks in Kenya. Apart from setting out the mandate of for KWS, the Act also sets the parameters for hunting, developments inside parks, general regulations, offences and punishments.	The Act will be significant in the management of aquatic wildlife resident in Lake Victoria throughout construction period.
Air Quality Regulations 2014	These regulations are aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air.	The proponent is obliged to address any source of air pollution from the operations of the project
Environment	The EMCA Wetlands, River Banks,	The principle of public

Management and Coordination Act (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009	Lake Shores and Sea Shore Management Regulations – 2009 ensures the conservation and sustainable use of wetlands, river banks, lake shores and sea shore. This regulation provides guidelines on management of these areas. This regulation also provides precautionary principal when working near wetlands in order to conserve them.	participation in the management of wetlands; the polluter-pays principle; the pre-cautionary principle; and the principle of public and private good shall be used in the management of wetland resources within Project area of Influence.
The Public Health Act Cap 242 Laws of Kenya	The Act contains comprehensive provisions on discharges of pollutants into watercourses among other prohibitions. The Act makes it the duty of every local authority (in the capacity of "health" authority) to take all lawful, necessary and reasonably practicable measures to safeguard and promote public health. The Act also makes provision for protecting from pollution sources of drinking water supply. Section 129 makes it the duty of the Local authorities to prevent such pollution, to purify a pollution source and to prosecute the polluters.	Health issues will be integrated into the project to ensure that occupational and public health is adequately addressed. The proponent and the contractor will work together to ensure compliance with provisions of this Act. Through consultation with other key stakeholders, the proponent will also put in place measures to mitigate all forms of nuisances including noise, air and water pollution.
Work Injury Benefits Act (WIBA)	This is an Act of Parliament to provide for compensation to workers for injuries suffered in the course of their employment. It outlines employer's liability for compensation for death or incapacity resulting from accident; compensation in fatal cases; compensation in case of permanent partial incapacity; compensation in case of temporary incapacity; and persons entitled to compensation and methods of calculating the earning. No compensation shall be payable under this Act in respect of any incapacity or death resulting from a deliberate self-injury. Notice of an accident, causing injury to a workman, of such a nature as would entitle him for compensation shall be given in the prescribed form to the director.	The proponent and/or his agents shall comply with obligations of employers as contained in the Act. In this regard, the proponent and/or his agents shall obtain and maintain an insurance policy, with an insurer approved by the Minister in respect of any liability that the employer may incur under the Act to any of his employees and shall register with the Director of Occupational Safety and Health Services as provided for in the Act. Employee compensation will be in compliance with provisions of the Act.
The National Land Commission Act 2012	An Act of Parliament to make further provision as to the functions and powers of the National Land Commission, qualifications and procedures for appointments to the Commission; to give effect to the objects and principles of devolved government in land management and administration, and for connected purposes. The objectives and functions of the National Land Commission as elaborated in the Act include management and administration of land in accordance with the principles of land policy set out in Article 60 of the Constitution and the national land	Land acquisition for purposes of implementation of the proposed project will be carried out in compliance with the provisions of this Act.

	policy.	

5.6 INTERNATIONAL AGREEMENTS AND CONVENTIONS

Table 5.3: International Agreements and Conventions Relevant to the Project

Agreement/Convention	Description	Relevance
Vienna Convention for the Protection of the Ozone Layer, 1985	Protection of the ozone layer, came into force in 1988,	Control of release of Ozone depleting gases into the atmosphere
Montreal Protocol on Substances that Deplete the Ozone Layer, 1989	Protection of the ozone layer.	Control of release of Ozone depleting gases into the atmosphere
United Nations Framework Convention on Climate Change (UNFCC), 1994	Control of greenhouse gas emissions.	Control of release of Greenhouse gases into the atmosphere
The Geneva Convention, 1979	Establishes protocols for emissions of sulphur dioxide, nitrogen oxides, volatile organic hydrocarbons, ammonia, persistent organic pollutants, and heavy metals	These gases must be managed in such a way that they are not released into the atmosphere
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 1971	The conservation and sustainable utilization of wetlands, i.e. to stem progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.	Release of raw effluents into the neighbouring Lake Victoria should not be allowed in compliance with the provisions of this convention
United Nations Convention on Biological Diversity, 1992	Promotes development of national strategies for the conservation and sustainable use of biological diversity. Often seen as the key document regarding sustainable development.	All biological resources within the project area should be sustainably managed for sustainability reasons
Constitution of the International Labor Organization	Promotes opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and human dignity.	Dignity of all employees engaged at this site should be maintained both during construction and operation phases of the project

5.7 REGULATORY FRAMEWORK

5.7.1 The Water Sector Regulations

5.7.1.1 General

The National Policy on Water Resources Management and Development and the Water Act 2016, presently guides water resources management. The overall goal of the National Water Development Policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way. This policy separates policy formulation, regulation and services provision and defines clear roles for sector actors within a decentralized institutional framework and includes private sector participation and increased community development. The following institutions are relevant for the successful implementation of the proposed project.

5.7.1.2 Ministry of Water, Irrigation and Sanitation (MoWIS)

This is the overall ministry in charge of water in Kenya. It is responsible for policy development; sector co-ordination; monitoring and supervision to ensure effective water and sewerage services in the country; sustainability of water resources; and development of water resources for irrigation, commercial, industrial, power generation and other uses. Its mission statement is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility.

5.7.1.3 Water Resources Authority (WRA)

The Authority is responsible for sustainable management of the nation's water resources; implementation of policies and strategies relating to management of water resources; development of principles, guidelines and procedures for the allocation of water; development of catchments level management strategies including appointment of catchments area advisory committees; regulation and protection of water resources quality from adverse impacts; and classification, monitoring and allocation of water resources.

5.7.1.4 Water Services Regulatory Board (WASREB)

The Regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. Its mandate include among others regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution; overseeing the implementation of policies and strategies relating to provision of water services; licensing of Water Services Boards and approving their appointed Water Services Providers; monitoring the performance of the Water Service Boards and Water Service Providers; inform the public on the sector performance; and gives advice to the Minister in charge of water affairs.

5.7.1.5 Lake Victoria South Water Works Development Agency (LVSWWDA)

Lake Victoria South Water Works Development Agency (LVSWWDA) is a state corporation under the Ministry of Water and Sanitation. It was preceded by Lake Victoria South Water Service Board (LVSWSB) established under the Water Act 2002 through Gazette Notice No. 1714 of 12th March 2004 with the mandate of ensuring efficient and economic provision of Water and Sanitation Services in its area of jurisdiction. The Agency is among the 8 Water Works Development Agencies established all over the country. The Water Act 2016 requires that LVSWWDA contracts agents i.e. Water Service Providers (WSP) to provide water and sanitation services on its behalf.

5.7.1.6 Water Sector Trust Fund (WSTF)

This body assists in the financing of the provision of water services to areas of Kenya that are without adequate water services. This shall include providing financing support to improved water services towards capital investment to community water schemes in underserved areas; capacity building activities and initiative among communities' water services activities outlined in the water services strategic plan as prioritized by the government; awareness creation and information dissemination regarding community management of water services; and active community participation in the management of water services.

5.7.1.7 Kisumu Water and Sanitation Company Limited (KIWASCO)

Kisumu Water and Sanitation Company Ltd was established through the reforms that took place in the water sector nationally and based on the decision to privatise essential services. The Company was established in July 2003 as an independent company after the transformation of the water and sewerage department of the then Kisumu Municipal Council. The core objective of KIWASCO is to make the water and sewerage services provision a commercial activity that generates sufficient revenue to sustain its operations throughout Kisumu City.

5.7.1.8 The County Government of Kisumu (CGK)

The passage of Kenya's 2010 constitution has had a wide set of implications for the water sector. Primarily, the constitution acknowledges access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to 47 newly established counties. The County government of Kisumu is therefore mandated to spearhead water and sanitation provision within Kisumu city in partnership with the local water service board.

5.7.1.9 National Environment Management Authority (NEMA)

NEMA is the administrative body that is responsible for the coordination of the various environmental management activities in Kenya. NEMA is also the principal government authority for implementing all environmental policies. NEMA is also responsible for granting EIA approvals and for monitoring and assessing activities in order to ensure that the environment is not degraded by such project activities.

5.8 EUROPEAN INVESTMENT BANK (EIB) ENVIRONMENTAL AND SOCIAL STANDARDS

5.8.1 Assessment and Management of Environmental and Social Impacts Risks

This Standard applies to all operations likely to have significant and material environmental and social impacts and risks. These impacts and risks need be taken into account at the earliest possible stage in all the technical planning and decision-making processes. The standard requires project proponents to carry out an environmental and social assessment for any project which is likely to have significant environmental and social impacts and risks.

5.8.2 Pollution Prevention an Abatement

Pollution prevention and control are key pillars of EU environmental policy that, in general, contribute significantly to the EU's broader objectives of smart, sustainable and inclusive growth. The objectives of this Standard includes among others the avoidance of any deterioration in the quality of human health or the environment, and any loss of biodiversity, by avoiding, reducing and, if possible, compensating/remedying significant adverse effects of projects supported by the EIB.

5.8.3 Biodiversity and Ecosystems

Biodiversity and healthy ecosystems are necessary for human survival and a good quality of life, but are being lost and degraded at a greatly accelerated rate because of human activities. Underpinning the Biodiversity and Ecosystem Standard of the EIB is the overall goal of maintaining the integrity of areas important for biodiversity as well as the natural functions, processes, and resilience of ecosystems, with the aim of achieving no net loss or a net gain of biodiversity and ecosystem.

5.8.4 Climate-Related Standards

The EIB Climate Standards, related to the value added by the EIB, require that its financing as a whole is aligned with EU climate policy. Specifically, the EIB is committed to making its lending portfolio more climate-friendly by promoting climate change mitigation projects in various sectors and promoting the adoption of energy efficient solutions in the projects financed; mainstream climate risk considerations generally into the project cycle and to promote adaptation projects or projects with adaptation components and measures, in the interests of long term sustainability among others.

5.8.5 Cultural Heritage

The objective of this Standard is to outline the proponent's responsibilities in terms of cultural heritage management, involving the actions taken to identify, assess, decide and enact decisions regarding the impact on cultural heritage associated with operations supported by the EIB. The standard aims to support the conservation of cultural heritage in the context of EIB operations and to protect cultural heritage from adverse impacts of project activities by promoting the cultural heritage impact assessment and management.

5.8.6 Involuntary Resettlement

The objective of this Standard is to outline the proponent's responsibilities in terms of cultural heritage management, involving the actions taken to identify, assess, decide and enact decisions regarding the impact on cultural heritage associated with operations supported by the EIB. The standard aims to support the conservation of cultural heritage in the context of EIB operations and to protect cultural heritage from adverse impacts of project activities by promoting the cultural heritage impact assessment and management.

5.8.7 Rights and Interests of Vulnerable Groups

Some individuals or groups may be less resilient to risks and adverse impacts than others. Within the context of EIB operations, individuals and/or groups who are at a higher risk of being unable to anticipate, cope with, resist and recover from project-related risks and/or adverse impacts are considered vulnerable. Vulnerable individuals or groups may include women, children, the elderly, the poor, ethnic, religious, cultural or linguistic minorities, or indigenous groups. This standard sets out to avoid or minimise, or otherwise mitigate and remedy, potential harmful effects of EIB operations to vulnerable individuals and groups whilst seeking that these populations duly benefit from such operations.

5.8.8 Labour Standards

The workforce is a valuable asset for any company. Sound management of human resources and of worker relations is key for sustainable business practices. The development of fair, safe and healthy working conditions based on respect for workers' rights fosters efficiency and productivity. In contrast, the failure to create and maintain sound worker-management relationships can undermine workforce commitment and effective project implementation. In these standards, the responsibilities of the project proponent are defined to ensure that the project embraces the principles of International Labour Standards.

5.8.9 Occupational and Public Health, Safety and Security

Projects often bring employment, economic growth and social improvement opportunities to both workers and communities. Project activities, however, can also increase exposure to hazards, risks and negative impacts in terms of public health and safety. These may arise through or be amplified by project-related occurrences such as increased environmental pollution; elevated noise levels the spread of communicable diseases or disproportionate use of violence by private or public security forces. These standards lay procedures to protect and secure public and occupational health, safety and security and promote dignity of workers and citizens affected by EIB operations.

5.8.10 Stakeholder Engagement

A meaningful engagement process allows for the efficient implementation of a financed operation and, in particular, the early and effective identification, assessment, and management of any environmental and social risks, impacts, and opportunities. The views, interests, and concerns of project affected communities and other interested stakeholders are heard, understood, and taken into account throughout the project lifecycle. The standard outlines a systematic approach to stakeholder engagement that the project proponent is expected to build and maintain by way of a constructive relationship with relevant stakeholders.

5.9 World Bank Environmental and Social Standards (ESS)

5.9.1 ESS1: Assessment and Management of Environmental and Social Risks and Impacts

These standards sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing (IPF), in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs).

5.9.2 ESS2: Labor and Working Conditions

This standard recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.

5.9.3 ESS3: Resources Efficiency and Pollution Prevention and Management

This standard recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life-cycle.

5.9.4 ESS4: Community Health and Safety

This standard addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable.

5.9.5 ESS5: Land Acquisition, Restrictions on Land use and Involuntary Ressettlement

Involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.

5.9.6 ESS10: Stakeholder Engagement and Information Disclosure

This standard recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

6. Environmental and Social Impact Assessment

6.1 INTRODUCTION

This chapter presents the assessment of the issues likely to emanate from implementation of the proposed project and associated infrastructure. For each issue, the analysis is based on its nature, the predicted impact, extent, duration, intensity, probability, and the stakeholders and/or values affected. In accordance with best practice, the analysis includes issues relating to the project's environmental and social sustainability. For potential negative impacts judged to be significant and require mitigation, the analysis is followed by notes on mitigation options. Impacts and their possible mitigation are combined in this chapter for easy reference. As in most impact studies, the analyses focus on potential problems and their solutions. Appropriate actions are included in the EMP (Chapter 9), and recommended immediate next steps are highlighted in Chapter 12.

6.2 IMPACT IDENTIFICATION

6.2.1 Sources of Impacts

The The impacts associated with the proposed project will emanate from project inputs, activities and outputs. The project inputs that shall be potential sources of impacts include materials taken from the local and external sources including sand and cement; skilled and unskilled workforce that will exert direct and indirect demand for energy, water supply, sanitation, health services etc.; and machinery to be used at the project site for various activities. The project activities that shall be potential sources of impacts include extraction of raw materials; transportation of raw materials, machinery and labour to the site; site preparation and clearance; topsoil removal; excavation works; disposal of excavated materials; disposal of surplus demolition and excavated materials; backfilling works and compaction. Project outputs likely to lead to adverse impacts include solid wastes (including sludge) from construction and operation (water treatment) activities; emissions from the site (hydrocarbons, Carbon dioxide, and particulate matter); noise pollution from construction activities and machinery and hazardous waste spillage

Table 6.1: Sources of Impacts

Project Inputs	Project Activities	Project Outputs
■ Materials taken from local and external sources ■ Skilled and unskilled workforce ■ Machinery used at the project site	■ Raw material extraction ■ Transportation of raw materials ■ Transportation of machinery ■ Transportation of labour ■ Site clearance ■ Excavation works ■ Spoil and waste disposal ■ Backfilling and compaction	■ Waste generated ■ Gaseous emissions from the site ■ Noise from site activities ■ Oil spills ■

6.2.2 Receptors of Impacts

The anticipated negative impacts will be received by both the physical and human environmental elements. Human environment likely to be affected by project activities include private properties located along the path of the raw water mains and residential housed located at the raw water intake point. Natural environment likely to be affected by project activities include surface water resources within the vicinity of the project (Lake Victoria) and vegetative materials located along the path of the proposed raw water mains.

Table 6.2: Receptors of Impacts

Human Environment	Physical Environment
■ Residential houses within project vicinity ■ Business premises within project vicinity ■ Academic institutions including schools ■ Workers at the site	■ Surface water resources ■ Ground water resources ■ Plants and animals within project alignment area ■ Ecologically sensitive areas ■ Soil

6.3 IMPACT ASSESSMENT CRITERIA

The criteria applied in this study are based on industry standards for impact assessment, adopted for use in the assessment of the proposed project impacts. The purpose of impact assessment is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The rating of impacts assumes that standard construction and operating procedures present in the project description will be implemented. The impact assessment criteria include the spatial context of project impacts; temporal context; and reversibility, magnitude and significance of potential impacts of project construction and operation. The potentially significant environmental and social impacts have been identified based on the nature of the receiving environment, analysis of the proposed activities and analysis of the issues raised by stakeholders during public participation process.

6.4 IMPACT ASSESSMENT METHODOLOGY

In the impact assessment criteria applied in this study is based on industry standards for impact assessment, adopted for use in the assessment of the proposed project. The purpose of impact assessment is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The rating of impacts assumes that standard construction and operating procedures present in the project design will be implemented. The impact assessment criteria include the spatial context of project impacts, temporal context, reversibility, magnitude and significance of potential impacts of project construction and operation. The potentially significant environmental impacts have been identified based on the nature of the receiving environment, a review of the proposed activities, and the issues raised in the public participation process.

6.4.1 Identification of Environmental Aspects and Impacts

The outstanding environmental and social issues identified as having significance have been assessed using the following methodology.

- First, the issues identified were described giving consideration to the associated activity and the aspect of that activity that is likely to result into an impact;
- The nature of the impact has been described;
- Once this was undertaken, the significance of the impact was determined.

6.5 DESCRIPTION OF ASPECTS AND IMPACTS

The accumulated knowledge and the findings of the environmental investigations form the basis for the prediction of impacts. Once a potential impact has been determined during screening and scoping process, it is necessary to identify which project activity will cause the impact, the probability of occurrence of the impact, and its magnitude and extent (spatial and temporal). This information is important for evaluating the significance of the impact, and for defining mitigation and monitoring strategies and has been used in this study. The aspects and impacts identified have been described based on the following criteria.

6.5.1 Spatial Scope

The spatial scope for each aspect, receptor and impact has been defined. The geographical coverage (spatial scope) description has taken account of the following factors:

- The physical extent/distribution of the aspect, receptor and the anticipated impact; and
- The nature of the baseline environment within the area of impact.

The spatial scope of the impact has been rated on the following scale:

Activity specific	1	Area specific	2	Whole site	3	Regional/ neighbouring areas	4	National	5

6.5.2 Duration

Duration refers to the length of time that the aspect may cause a change either positively or negatively on the environment. The environmental assessment has distinguished between different time periods by assigning a rating to duration based on the following scale:

One day to one month	1	One month to one year	2	One year to ten years	3	Life of operation	4	Post closure	5

6.5.3 Severity

The severity of environmental aspect has been determined by the degree of change to the baseline environment, and has included consideration of the following factors:

- The reversibility of the impact;
- The sensitivity of the receptor to the stressor;
- The impact duration, its permanency and whether it increases or decreases with time;
- Whether the aspect is controversial or would set a precedent; and
- The threat to environmental and health standards and objectives.

The following ratings have been used:

Insignificant/ non-harmful	1	Small/ potentially harmful	2	Significant/ slightly harmful	3	Great/ harmful	4	Disastrous/ extremely harmful	5

6.5.4 Frequency of Acivity

Frequency of activity has considered the repetitiveness of various project activities and how this may impact on the various receptors of the impacts. The following ratings have been used:

Annually or less	1	6 monthly	2	Monthly	3	Weekly	4	Daily	5

6.5.5 Frequency of Impact

The frequency of the impact occurring refers to how often the aspect impacts or may impact either positively or negatively on the environment. After describing the frequency the findings have been indicated on the following scale:

Almost never/ almost impossible	1	Very seldom/ highly unlikely	2	Infrequent/ unlikely/ seldom	3	Often/ regularly/ likely/ possible	4	Daily/highly likely/ definitely	5

6.6 Assessment of Significant Impacts

6.6.1 General

The purpose of impact evaluation is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The information presented above in terms of identifying and describing the aspects and impacts have been summarised in a tabular form and significance has been assigned with supporting rationale. Significance has been determined before and after mitigation, taking into consideration all the factors described above. A definition of a "significant impact" for the purposes of this study is: "An impact which, either in isolation or in combination with others, could, in the opinion of the specialist, have a material influence on the decision-making process, including the specification of mitigating measures."

6.6.2 Significance Determination

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which has already been assessed by the relevant specialist. The description and assessment of the aspects and impacts undertaken is presented in a consolidated table (Table 6.2) with the significance of the impact assigned using the process and matrix detailed below. The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the CONSEQUENCE of each impact. The sum of the last two criteria (frequency of activity and frequency of impact) determines the LIKELIHOOD of the impact occurring. The product of CONSEQUENCE and LIKELIHOOD leads to the assessment of the SIGNIFICANCE of the impact, shown in the significance matrix below.

Table 6.3:Significance Assessment Matrix

CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 6.4: Positive and Negative Mitigation Measures

Colour Code	Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
	Very high	126-150	Improve current management	Maintain current management
	High	101-125	Improve current management	Maintain current management
	Medium-high	76-100	Improve current management	Maintain current management
	Medium-low	51-75	Maintain current management	Improve current management
	Low	26-50	Maintain current management	Improve current management
	Very-low	1-25	Maintain current management	Improve current management

The model outcome is then assessed in terms of impact certainty and consideration of available information. Where a particular variable rationally requires weighting or an additional variable requires consideration, the model outcome is adjusted accordingly. Arguments for such adjustments are presented in the text and associated table.

Table 6.5: Framework for Assessing Environmental Impacts

SPATIAL SCOPE	RATING	DURATION	RATING	SEVERITY	RATING
Activity specific	1	One day to one month	1	Insignificant/ non-harmful	1
Area specific	2	One month to one year	2	Small/ potentially harmful	2
Whole site / plant	3	One year to ten years	3	Significant/ slightly harmful	3
Regional (neighbouring areas)	4	Life of operation	4	Great/harmful	4
National	5	Permanent	5	Disastrous/ extremely harmful	5

FREQUENCY OF ACTIVITY	RATING	FREQUENCY OF IMPACT	RATING
Annually or less	1	Almost never / almost impossible	1
6 monthly	2	Very seldom / highly unlikely	2
Monthly	3	Infrequent / unlikely / seldom	3
Weekly	4	Often / regularly / likely / possible	4
Daily	5	Daily / highly likely / definitely	5

SIGNIFICANCE OF IMPACT	TIMING
Very Low (1-25) Low (26-50) Medium -Low (51-75) Medium-High (76-100) High (101-125) Very High (126-150)	Pre-construction Construction Operation

6.7 Description of Feasible Alternatives

Although alternatives were investigated in detail during screening and scoping process, a review of the options based on the impact assessment have been undertaken in comparison with the preferred option.

6.8 MITIGATION

Measures to avoid, reduce or manage impacts consistent with best practice have been proposed and the effectiveness of such measures assessed in terms of their ability to avoid, remove an impact entirely, render it insignificant or reduce its magnitude. In assessing the significance of the impact, natural and existing mitigation have been taken into account. Natural and existing mitigation measures are defined as natural conditions, conditions inherent in the project design and existing management measures that alleviate (control, moderate or curb) impacts. In addition, the significance of impacts has been assessed taking into account any mitigation measures that are proposed.

6.9 EXISTING ENVIRONMENTAL AND SOCIAL IMPACTS

6.9.1 General

It was noted during the study that there are four treatment plants built at different periods with a combined treatment capacity of 45,000m3 of water per day. The latest plant that was built recently has a treatment capacity of 24,000m3 per day and the rest of the plants have a combined treatment capacity of 21,000m3 per day. The water gets into the treatment plants via an inlet chamber through a 500DN pipe then to distribution tanks from where it is distributed to other treatment plants. Filter media for all the treatment facilities are sand and pebbles. Sludge is drained from the sedimentation tanks to sludge chambers located next to the tanks and then flushed into the lake. A number of chemicals are used in the treatment process. Soda ash is used to correct the pH while Chlorine is used to kill bacteria. Norc flow is also used as flocculant at the treatment plant. These are contained in the chemical house from where they are pumped to various locations within the treatment process. Routine samples are taken from the tanks and sedimentation chambers every two hours. Other than internal water quality monitoring carried out by the operator, external monitoring is also carried out by Lake Victoria Environment Management Programme (LEVEMP) and Kenya Bureau of Standards (KeBS). The following is a summary of impacts and issues noted at the raw water intake and water treatment plant sites during the study.

6.9.2 Problem of algal bloom

A rapid increase in the population of green algae in the treated water has been noted. This has been recognized by the discoloration in the water from their pigments. There is therefore need for the treatment process to be carried out such that the green algae are adequately managed.

6.9.3 Private developments around the raw water intake and water treatment plant

Several private developments are being initiated around the Water Treatment Plant and the raw water intake point. Developments around the intake point have the potential to increase pollution load within the intake area which may in the long run have adverse impacts on water quality at the treatment plant. Heavily polluted water may strain treatment capacity of the treatment plant and this has the potential adverse impacts on consumers. Proliferation of developments around the treatment plant will also starve the facility of land that may be required for future expansion.

Figure 6.1: Private developments around the water treatment plant

6.9.4 Cross connection of pipes at the intake point

A number of pipe cross connections was noted at the Dunga raw water intake point in Lake Victoria during this study. This can be attributed to the upgrading of the intake system over time which has been associated with construction of raw water mains and pump houses. This piping and pumping arrangement may have the potential for capacity restriction and should be harmonized.

6.9.5 Release of backwash water into the lake

Release of backwashed water into the lake was noted at the water treatment plant. It is important to note that water from filtration process is already treated water and should be sustainably used. It is also significant to note that water is pumped from the lake using energy and any loss of pumped water is a loss in energy cost. There is therefore need to harness this water back to the treatment system to avoid this loss.

6.9.6 Flushing of sludge into the lake

Release of sludge from the sedimentation tanks into the lake was noted during this study. This sludge is released together with the flushing water. It is important to note that sludge from the sedimentation tanks contain significant levels of pollutants which when released back into the lake contributes to pollution load of the lake water. The backwash water should also not be wasted as this amount to unsustainable resource use. Due to the fact that this is a pumping system, energy is used to pump the water to the treatment facility and this water should therefore be harnessed back into the treatment system to attain zero discharge.

Figure 6.2: Backwash water released to the lake

6.9.7 Ineffective water treatment process

It was noted during this study that the treatment process as currently operated is geared more towards improving the aesthetic qualities of the water. The health related contaminants including microorganisms such as Giardia, cryptosporidium, viruses and low levels of harmful chemicals including Trihalomethanes (TTHMs) that may be present in very small amounts in water may pass through the treatment process.

6.9.8 Aging water treatment infrastructure

The treatment plants shows clear signs of aging and this can be attributed to the fact that some of the plants were constructed about sixty year ago. There is therefore great need to rehabilitate them and replace worn out parts as appropriate.

6.9.9 Lack of sludge drying beds at the treatment plant

The design of the water treatment plant does not include onsite sludge drying. This state of affairs has led to a situation where sludge is flushed into Lake Victoria and this contributes to pollution load of the lake. There is therefore need to have a properly constructed sludge drying bed where sludge resulting from the treatment process can be dried before disposal in compliance with applicable rules and regulations.

Figure 6.3: Sludge collected in sludge chambers at the site

6.9.10 Heavy dependence of power from the national grid

There is heavy dependence on power from the national grid as the main source of energy both at the raw water intake point and at the water treatment plant. Due to power outages associated with grid power, this may slow down significant processes associated with water treatment and especially once the system is upgraded. There is need to think of a long-term power solution from green sources. Wind and solar power should be considered in the long term as alternative energy sources in an hybrid system with grid power.

6.10 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.10.1 Impacts during construction phase

6.10.1.1 Impacts of obtaining construction materials

The project will require some amount of materials for construction of project related infrastructure. Specific sources for these materials have not been identified. The project will require both borrow pits (for soil) and quarries (for rock). These need to be sited, accessed, operated and closed so as to avoid archaeologically sensitive sites, minimise impacts on land users and avoid the creation of safety or health hazards (e.g. steep slopes, malarial ponds etc). The project will also require sand. Sand mining from rivers is associated with habitat destruction due to changes in channel morphology.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	5	2	3	4	4	10	8	80
	National	One month to one year	Significant	Weekly	Likely			Medium-High
Mitigation Measures	• Maximise the re-use of excavated materials in the works, as fill. • Site quarries and borrow pits carefully so as to minimise impacts on existing land uses. • Strip all available topsoil from borrow pits and quarries and store it safely for use in site restoration. • Close all borrow pits and quarries in accordance with an approved plan to maximise their long-term							

	biological productivity (capacity for plant growth) and minimise health and safety hazards. • Carry out EIA for quarry site if new quarries are to be opened for purposes of this project • Include a provision in the tender documents that where goods and services are of equal quality, those sourced from an organisation implementing a certified EMS and/or CSR approach will be preferred.							
With mitigation Measures	2 Area specific	1 One day to one month	1 Non harmful	2 Six monthly	1 Almost impossible	4	3	12 Very Low

6.10.1.2 *Accidents and Injuries to workers*

Activities associated with construction such as excavating of trenches, movement of construction vehicles, the use of equipment and the congregation of workers and staff on site increase the risk of injury. Work at the proposed site may involve hazards such as accidental falls into open trenches, slippery walkways, working at heights, exposure to energized circuits, and heavy equipment. Work at the project site will also involve working in water during construction of the Intake Works and this will be associated with risks of drowning and attacks by aquatic animals and reptiles including crocodiles.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	3 Whole site	2 One month to one year	4 Harmful	5 Daily	4 Likely	9	9	81 Medium-High
Mitigation Measures	• The Contractor shall conform to all the stipulations of the Occupational Health and Safety Act, 2007. The Act requires the designation of a Health and Safety representative when more than 20 employees are deployed; • The contractor shall provide ample warning signs, guard rails, warning tape, etc., around open excavations, stacks of material, debris, etc. and shall be held liable for all claims as a result of neglect of such precautions and provisions; • Proper access control should be enforced to ensure that no unauthorised persons enter the site; • Material delivery vehicles should be under the control of competent personnel. Ensure that persons handling equipment and materials are suitably trained, supervised and adequately instructed; • Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; • Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. • Valves to storage tanks should be locked to prevent accidental flooding during maintenance; • Use of requisite Personal Protective Equipment (PPE) at all times during construction works • Use fall protection equipment when working at heights; • Maintain work areas to minimize slipping and tripping hazards;							
With mitigation Measures	1 Activity specific	2 One month to one year	1 Non harmful	5 Daily	1 Almost impossible	4	6	24 Very Low

6.10.1.3 *Solid waste generation*

Construction will result in the generation of various solid wastes materials, principally surplus aggregates, metal scraps, plastics (wrappings and containers) and wood. Rehabilitation of the treatment plants will also be associated with limited demolition wastes and sludge from sedimentation basin. Solid waste will also be generated from contractor's camp.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	2 Regional	2 One month to one year	2 Potentially harmful	5 Six monthly	3 Likely	6	8	48 Medium to low
Mitigation Measures	• Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable to the supervising architect and environmental consultant; • Construction site management plans will be required for all works. This plan will include a waste management plan for all activities during the construction period. • Minimize the quantity of solids generated by the water treatment process through optimizing coagulation processes; • Dispose of lime sludges by land application at a solid waste disposal site approved by the local authority							

	and in compliance with Solid Waste Regulations 2006. • Bins/ receptacles shall be placed at strategic locations within the site as collection centres to facilitate separation and sorting of the various types of wastes; • The contractor shall work hand in hand with private waste handlers and local council to facilitate sound waste management; and • The wastes shall be properly segregated and separated to encourage recycling of some useful waste materials.							
With mitigation Measures	1 Activity specific	1 One month to one year	1 Non harmful	5 Daily	1 Almost impossible	3	6	18 Very Low

6.10.1.4 *Atmospheric Pollution*

The expected air pollutants from the proposed project will include dust, particulate matter and gaseous emissions from construction equipment. Dust will be generated from excavations and earth moving at the proposed site for construction of sludge drying beds and materials delivery. Particulate matter will come from dry materials including sand, cement, gravel, murram, etc. Smoke, hydrocarbons and nitrogenous gases will be emitted from machinery exhausts. These will be expected to increase slightly and will be localized hence expected to be experienced within about 30 metres of the construction site. Air pollution is expected to be low key as the project is not associated with significant earth moving works.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	4 Regional	2 One month to one year	3 Harmful	5 Daily	3 Infrequent	9	8	72 Medium-Low
Mitigation Measures	• Impose speed limits (10 km/h in all areas within the site boundaries); • Damping down of access roads, stockpiles and cleared areas must take place to minimize dust pollution. • Ensure that no refuse wastes are burnt on the premises or surroundings. Refuse wastes should be removed by an official contractor and dumped at an approved site in compliance with local laws and regulations. More significantly, an Integrated Solid Waste Management system is encouraged. • Proper rehabilitation and restoration of disturbed areas is required in order to minimize bare patches. • Vehicles to be used during the construction phase are to be kept in good working condition and should not be the source of excessive fumes. • Sprinkle water before undertaking very dusty operations to reduce dust pollution.							
With mitigation Measures	1 Activity specific	1 One day to one month	1 Non harmful	3 Monthly	1 Almost impossible	3	4	12 Very Low

6.10.1.5 *Noise Impact*

Construction activities associated with the proposed project are likely to lead to slight increase in noise level although noise impact is not expected to be significant. Use of heavy construction machinery is not anticipated in this project except at the sludge drying bed construction site hence noise impact will be minimal and can easily be mitigated through implementation of mitigation measures suggested below.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	1 Activity specific	2 One month to one year	2 Potentially harmful	2 Six monthly	4 Likely	5	6	24 Very low
Mitigation Measures	• Schedule road traffic movements to normal working hours (08H00 –17H00). • Silencers on equipment such as generators will be properly designed. • Where need be, all exposed workers will be provided with functional ear muffs, whose use is mandatory, and closely enforced, monitored and supervised.							
With mitigation Measures	1 Activity specific	2 One month to one year	1 Non harmful	2 Six monthly	1 Almost impossible	4	3	12 Very Low

6.10.2 Impacts during Operation Phase

6.10.2.1 Hazardous Chemicals

Water treatment will involve the use of chemicals for coagulation, disinfection and water conditioning. Chlorine is one of the most used chemical in water treatment. Exposure to hazardous chemicals used in the water treatment process have the potential of leading to long term impacts especially on children below five years. The impacts may be felt both at the local and regional levels. The severity of the impact will be medium but will be low with implementation of mitigation measures.

Significance of Impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	4	1	2	4	3	7	7	49
	Regional	One day to one month	Potentially harmful	Weekly	Infrequent			Low
Mitigation Measures	• Minimize the amount of chlorination chemicals stored on site while maintaining a sufficient inventory to cover intermittent disruptions in supply; • Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; • Develop and implement a plan for responding to accidental releases.							
With mitigation Measures	2	1	1	3	1	4	4	16
	Area specific	One day to one month	Non harmful	Monthly	Almost impossible			Very Low

6.10.2.2 Contamination of water at the intake works

The water supplies can become contaminated with potentially toxic substances of natural and anthropogenic origins, including pathogens, toxic metals (e.g. arsenic), anions (e.g. nitrate), and organic compounds at the source. Such contamination might result from natural sources, actions or releases that are routine (e.g. discharges within permit limits), accidental (e.g. from a spill), or intentional (e.g. sabotage). There are already existing and planned development projects around the intake area and this may significantly contribute to increased pollution loads around the raw water intake area.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	4	2	4	5	3	10	8	80
	Regional	One month to one year	Harmful	Daily	infrequent			Medium-High
Mitigation Measures	(i) Identify potential sources of contamination within the headworks and collaborate with public authorities in the implementation of management approaches to protect the source water quality, such as: • Facility inspection or hazardous material survey program • Information to water service providers and individual consumers concerning applicable requirements • Strategic monitoring within area • Incorporation of surface water protection into regional land use planning (ii) Evaluate the vulnerability of the water source to disruption or natural events, and implement appropriate security measures as necessary, such as: • Continuously monitor raw water for surrogate parameters (such as pH, conductivity, total organic carbon [TOC], and toxicity) • Inspect sites at random times							
With mitigation Measures	2	1	1	5	1	4	6	24
	Area specific	One day to one month	Non harmful	Daily	Almost impossible			Very Low

6.10.2.3 Contamination of drinking water from treatment operations

An adequate supply of clean drinking water is critical to community health and hygiene. Hazardous chemical associated with the treatment process is Chlorine. If residual levels of chlorine are beyond the recommended limits, there would be long term impacts on health of the consumers and especially children below five years.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	4	2	2	5	3	8	8	64
	Regional	One month to one year	Potentially harmful	Daily	Infrequent			Medium-Low
Mitigation Measures	• Install alarm and safety systems, including automatic shutoff valves that are automatically activated when a chlorine release is detected; • Use corrosion-resistant piping, valves, metering equipment, and any other equipment coming in contact with chlorine, and keep this equipment free from contaminants, including oil and grease; • Construct, operate and maintain the water treatment facility in accordance with national requirements and internationally accepted standards to meet national water quality standards and WHO Guidelines for Drinking Water Quality ; • Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; and • Evaluate the vulnerability of the treatment system and implement appropriate security measures, such as background checks of employees, perimeter fencing and video surveillance and improve the electrical power feeds to the facilities.							
With mitigation Measures	2	1	1	5	1	4	6	24
	Area specific	One day to one month	Non harmful	Daily	Almost impossible			Very Low

7. Project Option/Alternatives

7.1 No Project Option

This option presupposes that the status quo remains and the Raw Water Intake and Treatment Plant remain as they are presently. It is important to note that since the commissioning of the first raw water pumping station in 1958, the Hippo Point site has undergone several rehabilitations and upgrading, and now constitutes 3 separate intakes and related pumping stations. The gradual upgrading of the raw water intake over time has led to a rather cumbersome pumping and piping arrangement that may be linked with potential capacity restrictions. Lower pumped flows can lead to early wear of equipment; for instance, the two check-valves (single-door type) in operation on the DN400 line exiting the new building do clearly not function properly. Regarding Dunga Water Treatment Plant, a number of issues have been noticed that require urgent attention. Presently, sludge builds-up after 8 days, which will become an even more severe issue when demand increases. Potential reasons include the fact that raw water turbidity lies between 70 and 200 NTU. There seems to be a sedimentation tank design deficiency in sludge settling and removal. A probable cause could be that the quantity of suspended solids in the raw water was underestimated which resulted in an incorrect dimension of the tanks.

The sludge removal process usually involves alternate emptying of the tanks. This results in large volumes of water being lost from the system as there is no recirculation system in place. Furthermore, half the treatment capacity is offline during this process which may not be affordable once water demand increases. It should also be noted that all raw water is pumped from the lake; hence any loss is a wasted energy cost. Highlift pumps at Dunga WTP do not work at an efficient pumping regime. Discharge valves in clear water pumping stations are not motorized and it is needed to start pumps against partially closed valves in present situation. Measurement and monitoring of Dunga water supply system is also not effective. The bulk water meters previously installed, have challenges of malfunctioning. It is suspected that the system installation on direct line of pumping could be the cause or debris from the raw water.

Sections of Dunga Water Treatment works was constructed over 50 years ago and was designed to cope with a much smaller demand. Given the city's rapidly increasing population, water supply shortages are likely to worsen if the "No Project" option is pursued. It was also noted that the treatment facilities at Dunga and Kajulu Water Treatment Plants have not been properly maintained and, as a result, have not been operating at full capacity. A 2008 study reports that Kisumu's water supply facilities had a combined design capacities of 22,700 m3/ day, but were operating at a capacity of only 18,700 m3/day, with Kajulu supplying 1,700 m3/day and the Dunga Water Treatment Plant producing 17,000 m3/day (LVSWWDA, 2008). The study estimated that water demand in 2007 was 47,700 m3/day, leaving Kisumu with a supply deficit for that year of over 29,000 m3/day.

7.2 Proposed Project Options

7.2.1 Options for barrier against Water Hyacinth

Water hyacinth (Eichhornia crassipes) has been widely described as one of the world's worst weeds. It is a free-floating and highly invasive aquatic plant that rapidly forms dense and impenetrable floating mats in freshwater systems. Near water intake pipes, water hyacinths can be sucked up and cause clogging of the pumps. To remedy this problem, it is essential to keep these plants away. The barriers are essential to filter the water and promote the influx of water necessary for the proper functioning of the pumps.

7.2.1.1 Option 1: Floating booms

Floating booms are used to keep areas of water hyacinth contained in one area and are best used on calm and sheltered waters. Regular monitoring and maintenance is required as damage can be caused to the boom by floating debris and/or stock if allowed access to the area. Small areas of

water hyacinth can be contained with temporary booms made with nets or rope; larger infestations will generally require stronger and more permanent booms. Floating booms can range in size and capability, usually varying between 0 and 50 mm above the surface of the water.

7.2.1.2 Option 2: Containment fences`

Containment fences are normally used on areas where water is flowing. Water hyacinth and other water weeds are stopped by the fence from spreading further. Fences can be made of wire mesh and constructed in front of intake pipes. The mesh is anchored on either side with steel pickets or micropiles and held in place with round tube steel. Due to the weight and mass of large infestations of water hyacinth, fences should be monitored regularly for signs of wear and damage, and to remove any debris.

7.2.1.3 Option 3: Prefabricated reinforced concrete structure

This is a sustainable solution consisting in placing the water intakes in a structure protecting the intakes from the intrusion of water hyacinths while offering sufficient water flow for its needs. The structure can be prefabricated and placed around the water intake using a mobile crane. The elements of the structure will be placed on the bottom of the lake (with a resistant seabed) and tightened one by one under the effect of their weight. Metal grid windows would allow the structure to be filled with water. These grilles can be dismantled and cleaned and then replaced in the reservation on the concrete structure. The cleaning operation can only be carried out when the pumps are stopped. The current fences would be dismantled and replaced by another structure adapted to the new configuration. The installation of this structure will be as follows:

- Prefabrication of reinforced concrete elements;
- Adjustment of the foundation of the blocks (reinforcement by boulders if necessary);
- Transport of the elements on site;
- Handling and placing blocks by a telescopic crane;
- Assembly of water intakes;
- Installation of the grids;
- Pumping water after cleaning.

The advantages of this solution are myriad. Firstly, all materials are available and do not require importation. It is also a durable solution over time. Time can be saved with the prefabrication of elements and the system is easy to maintain and does not require specialized labour.

7.2.1.4 Recommendation

While option 1 (floating booms) could be a suitable short term solution (for a few years), Option 3 (prefabricated reinforced concrete structure) is the recommended option since it is the most durable and is easy to maintain and to implement.

7.2.2 Options for Intake Works

Three options have been considered for rehabilitation and improvement of the pumping stations and associated infrastructure. They include the following:

- Option 1: Decommission of 1958 pumping station and rehabilitation and reinforcement of 2007/2011 pumping station to 43,200 m³/day capacity and rehabilitation of 1985 pumping station to 2,880 m³/day capacity;
- Option 2: Decommission of 1958 and 1985 pumping stations and rehabilitation and reinforcement of 2007/2011 pumping station to full 46,080 m³/day capacity;
- Option 3: Decommission of 1958 pumping station and rehabilitation and reinforcement of 2007/2011 pumping station to full 46,080 m³/day capacity and rehabilitation and reinforcement of 1985 pumping station to 20,000 m³/day capacity.

All options include the following additional works:

- Corresponding alignments and headlosses reduction works on transmission lines;
- Corresponding replacement of transmission lines;
- Corresponding electromechanical works (electrical panels, replacement of valves and meters, etc.);
- Corresponding civil works: repair of 1985 pumping station building, valve chamber, pipe supports and fence, as well as barrier against water hyacinths.

7.2.2.1 Option 1: Decommission of 1958 pumping station

This option consists in the decommission of the 1958 pumping station at the intake and the rehabilitation / reinforcement of the other two pumping stations in order to reach the necessary flows to satisfy the design capacity of the different files of Dunga WTP. The cost estimates for option one is 488,600 Euros. Option 1 entails the following:

Table 7.1:Activities for Option 1 Raw Water Intake

Pump Station	Activity	Output (m^3/d)	Comments
1958	Decommission	0	Decommission of transmission line
1985	Rehabilitate	2,880	Discharge through 1 x DN300 to WTP P1 & 2
2007	Use existing	17,280 to phase I and II	Discharge through existing DN400 to WTP P1 & 2
2011	Reinforce with one more pump	25,920 to phase III	Discharge through existing DN500 to WTP P1 & 2

7.2.2.2 Option 2: Decommission of 1958 and 1985 pumping stations

This option consists in the decommission of the 1958 and 1985 pumping stations at the intake and the rehabilitation / reinforcement of the 2007 and 2011 pumping stations in order to reach the necessary flows to satisfy the design capacity of the different files of Dunga WTP. The cost estimates for option 2 is 609,050.00 Euros. Option 2 entails the following:

Table 7.2:Activities for Option 2 Raw Water Intake Works

Pump Station	Activity	Output (m^3/d)	Comments
1958	Decommission	0	Decommission of transmission line
1985	Decommission	0	Decommission of transmission line
2007	Reinforce	20,160 to Phases I and II	Discharge through existing DN400
2011	Rehabilitate	25,920 to phase III	Discharge through existing DN500

7.2.2.3 Option 3: Decommission of 1958 pumping stations and reinforcement of 1985 pumping station's capacity to 20,000 m³/day

This option consists in the decommission of the 1958 pumping station at the intake and the rehabilitation / reinforcement of the other pumping stations in order to reach the necessary flows to satisfy the design capacity of the different files of Dunga WTP, and have the 1985 pumping station as a standby of the 2007 pumping station. In addition, considering the poor state of the two DN300 GI transmission mains, a new DN500 transmission main between the 1985 pumping station and Dunga WTP Phases 1 & 2 would be necessary to convey the flows from the 1985 pumping station. The cost estimates for Option 3 will is 1, 457, 645.00 Euros. Option 3 entails the following:

Table 7.3:Activities for Option 3 Raw Water Intake Works

Pump Station	Activity	Output (m³/d)	Comments
1958	Decommission	0	Decommission of transmission line
1985	Reinforce	20,160 to Phases I and II	Discharge through new DN500 to WTP P1 and 2
2007	Reinforce	20,160 to Phases I and II	Discharge through existing DN400 to WTP P1 and 2
2011	Reinforce with one more pump	25,920 to phase III	Discharge through existing DN500 to WTP P3

7.2.2.4 Comparison of options

The following criteria and weights are considered for the comparison of options:

7.2.2.4.1 Financial criteria

Financial criteria have been looked at in terms of capital cost and operation and maintenance cost. In terms of capital cost, option 1 is the cheapest since it conserves the three existing pumps in the 1985 pumping station. Option 3, requiring the installation of a whole new pumping station, is considerably more expensive than the other two options (76% more than Option 1 and 60% more than Option 2). For operation and maintenance cost, option 1 requires the operation of one more pump than option 2, decreasing the efficiency of the system. Option 3 has slightly less operational costs than option 2 (since the 1985 pumping station would be used as a standby, but with a new transmission mains headlosses would be slightly reduced) but high maintenance costs, with more pumps needed to be replaced once their life expectancy has been reached.

7.2.2.4.2 Technical criteria

Technical criteria were looked at in terms of ease of operation and maintenance and resilience. At design capacity, Option 1 requires the permanent operation of the 1985 pumping station in parallel with the 2007 pumping station, making the operation more complex. Option 3 requires the operator to switch regularly from the 1985 pumping station to the 2007 pumping station. In terms of resilience, option 3 is the most resilience, since a whole additional pumping station and transmission line could be used as a standby. Option 1 is slightly more resilient than Option 2 since it enables supplying some water to Dunga WTP1&2 (≈180 m³/h) even in case of failure of the existing DN400 steel pipe.

7.2.2.4.3 Environmental and social impact criteria:

Both Options 1 and 2 have low environmental and social impact since all works are to be carried out within the intake site. Option 3 requires the installation of a new DN500 transmission line between Dunga intake and Dunga WTP (≈1km), thus creating more social disturbances and potential environmental impacts.

7.2.2.4.4 Recommendation

Option 2: Decommission of 1958 and 1985 pumping stations is therefore the recommended option for implementation.

7.2.3 Options for Dunga Water Treatment Plant (WTP)

Two options were considered with regard to water treatment plant. Option 1 presupposes a situation where the water quality analyses show the absence of cyanobacteria, cyanotoxins and pesticides while option 2 presupposes a situation where the water quality analyses show the presence of cyanobacteria and/or cyanotoxins, and/or pesticides.

7.2.3.1 Option 1: No treatment process modification necessary

If the water quality analyses indicate the absence of pesticides and cyanobacteria, Dunga WTP's process, consisting of aeration, coagulation/flocculation, decantation, sand filtration and disinfection, is suitable for the treatment of surface water. In this case there is no need to modify significantly the Dunga WTP's treatment process. The works proposed will be limited to the optimization of the existing structures and equipment for a better operation of the WTP. One can note that this option is relatively unlikely considering previous publications (Pr.Humbert, Sitoki, Gichuki, Semyalo, etc.) reporting the presence of cyanobacteria and cyanotoxins in Lake Victoria.

7.2.3.2 Option 2: Necessary modification of the treatment process

As for all shallow lakes, the Winam Gulf (where Dunga intake is located) is vulnerable to pollutants due to its relatively low volume of water compared to its surface. As mentioned by Pr. Humbert in the report *Water Quality Monitoring in the Winam gulf (Kisumu – August 2015)* cyanobacterial blooms have been reported in the Winam Gulf. As the species of cyanobacteria producing microcystis is able to bloom in much contrasted ecosystems, microcystis seems to have been the dominant toxin found in recent years. Relating to the works envisaged for the protection of the water intake from water hyacinths, it should be noted that Pr. Humbert has indicated that the removal of water hyacinths can have undesirable effects on the water quality of a shallow lake: it can promote cyanobacterial blooms of and a state of permanent anoxia near the bottom of the lake.

7.2.3.3 Comparison of Options

7.2.3.3.1 Technical comparison

With Option 1, no improvements are expected since no changes are proposed. Based on the results obtained in the Winam Gulf by Okello (2010), microcystin concentrations in water range from 1 to 2 µg/l. Sitoki (2012) has recorded the higher microcystin concentrations (81 µg/l) between November and March. With Option 2 and the corresponding 90% removal of the microcystins with the injection of Powdered Activated Carbon (PAC), concentrations would only drop below the minimum WHO Guidelines values of 1 µg/l if the concentration in the Lake is below 10µg/l. In any case the addition of PAC in the treatment process would much improve the quality of the water, even if, as Sitoki (2012) suggests it might not be sufficient to satisfy WHO's requirements at all times.

7.2.3.3.2 Financial comparison

In Option 1, there is no additional investment cost to be considered since there is no change in the treatment process other than those common to both options. However, it should be noted that the correct operation of the existing treatment process requires the proper operation of the electromechanical equipment, an efficient purge of the sludge and sand in the regular washed sand filters. In Option 2, the estimated treatment step of injection of PAC is 150,000EUR for the investment and 739,125EUR for the operation:

7.2.3.4 Recommendations

Option 2 has been recommended for implementation

7.2.4 Sludge Collection and Treatment

The current situation does not allow for a proper sludge collection system from the decantation tanks. As a consequence, when the tanks are emptied, the sludge chamber overflows and the WTP compound is partially flooded. For a proper operation of the WTP, the sludge collection system shall be refurbished and sludge treatment shall be implemented. Implementing sludge treatment requires a large surface, seemingly not available on the existing site. Land acquisition would

therefore be necessary. The recommended system for Dunga sludge treatment would be composed of a Buffer tank; a thickener; and drying beds. A buffer tank is necessary upstream of the sludge treatment system in order to collect and homogenize the effluent collected from the water treatment steps. The thickener shall be of the static type equipped with a harrow. It will be supplied with sludge coming from the buffer tank and will be used as storage before the drying stage. Drying beds make it possible to obtain high dryness feature, by simple filtration under very low pressure and favourable weather conditions. This treatment process requires at least two structures, in order to alternate the filling and the drying stages.

8. Public Consultation

8.1 Background to Public Participation

Informing and consulting the public are integral tasks within any environmental assessment process in Kenya and forms part of best practice. Accordingly, the ToR required the ESIA consultant to organise and implement a public consultation exercise while undertaking the ESIA process. Consultations of interested and affected parties (IAPs) in this project were carried out to inform the local people and key stakeholders about the proposed project and its objectives; to seek views, concerns and opinions of the project stakeholders concerning the proposed project; and to establish if the local people foresee any positive or negative environmental and social impact which may arise as a result of implementation of the proposed project and how they would like the identified adverse impacts to be addressed.

8.2 Approaches to Public Participation

Informing the local people, leaders and key stakeholders about the proposed project was carried out through direct interviews, key informant interviews, questionnaire administration, email communication and telephone calls. Stakeholders consulted were supplied with information regarding the proposed project including its objectives, technologies of implementation and possible impacts associated with its implementation and mitigation measures proposed to deal with adverse environmental and social impacts noted.

8.3 Determination of who should be involved in the ESIA

The ESIA study benefited from targeted stakeholder consultations with a critical people who have roles in implementation of the proposed project and also those who may be affected in one way or the other due to project implementation. This was achieved through stakeholder analysis which was conducted to identify stakeholders who should be involved in the ESIA process. The basis of inclusion of these stakeholders was informed by their relevance, significance and importance in implementation of the proposed project.

Stakeholder relevance was determined through consideration of stakeholder activities within the project area and how various elements and components of the proposed project are likely to impact on specific stakeholder groups. Stakeholder importance and significance were looked at from the point of view of roles of various stakeholders in the provision and management of water and sanitation services within the project area.

Stakeholders were categorised into two groups for purposes of this study. The first group consisted of institutional stakeholders and the second group consisted of community stakeholders. The institutional stakeholders were drawn from Lake Victoria South Water Works Development Agency; officials of the national and county governments within Kisumu County; members of various groups operating within the project area and representatives of Kisumu Water and Sanitation Company (KIWASCO). Community stakeholders on the other hand mainly consisted of members of the public residing within the project area.

8.4 Methods used to consult various Stakeholders

The following is a summary of the methods used to consult various stakeholders during the ESIA process.

8.4.1 Key Informant Interviews

One-on-one interviews with key stakeholders within the project area were undertaken in order to gather baseline information of the project area and also to assist in analysis of existing and anticipated impacts of project activities to the environment, local community and institutions within

the project area. These interviews were conducted to augment and confirm data and information obtained using other tools and methodologies. The interviews were focused on getting information from key stakeholders within the project area and focused on stakeholders in water and sanitation sector within the project area. Among those consulted through this method include departmental heads within Kisumu Water and Sanitation Company, representatives of youth groups, representative of welfare groups, representatives of women groups, area Chiefs and Assistant Chiefs, Village Elders and individuals within Lake Victoria South Water Works Development Agency.

8.4.2 Direct Interviews

Interviews were conducted within the project area and this targeted those living within the proposed project area and who were unable to fill in the questionnaires for one reason or the other. The interviews were conducted to augment and confirm data and information obtained using other tools and methodologies and focused on water issues and problems experienced by area residents. Respondents were also asked how they would like the identified negative impacts to be addressed both during project construction and operation phases.

8.4.3 Questionnaire Administration

Questionnaires were prepared and administered to the various stakeholders identified at the initial stages of the study. The questionnaires were administered along the proposed water and wastewater lines and contained questions on water quality and access; wastewater and solid waste management; physical and biotic factors; and anticipated impacts on the environment, neighboring populations, facilities and structures. Those to whom questionnaires were administered were mainly individuals living within the vicinity of the project site and who could be affected by project activities in one way or the other. The assessors visited them in their homes and business premises where they were guided to fill in the questionnaires. Sample questionnaires have been annexed to Appendix 1 of this Study Report.

8.4.4 Community consultative meetings

A number of consultative meetings were held with a cross section of project stakeholders during ESIA process. The meetings served two purposes; first they offered an opportunity for stakeholder sensitisation on the proposed project. Secondly, they presented an opportunity for the ESIA study team to gather data and information on contentious issues relating to implementation of the proposed project. To better address the later objective, participants were first taken through the key highlights of the issues to be explored under the ESIA study. Through a question and answer session, stakeholders were given opportunity to understand the implication of the proposed project on the environment and local populations.

8.4.5 Public meeting

One public meeting was held during ESIA study at the Tom Mboya Labour College which located within the vicinity of project site. The meeting was part of public consultation process and was meant to inform the local community about the proposed water project and also seek their views about the same. The meeting also presented the community members and the potentially affected persons (PAPs) with the opportunity to freely express their views concerning the proposed project. The meeting was open to members of the public and the mobilization of community members was done by the Area Chief (see annex 2 for minutes of the meeting).

Figure 8.1:ESIA Expert addressing a public meeting during the study

8.5 COMMENTS FROM THOSE CONSULTED

The stakeholders contacted during ESIA study are happy with the proposed rehabilitation and improvement of the Dunga Raw Water Intake and Treatment Plant. Their position is based on the current conditions of facilities at the intake and water treatment plant. They feel that rehabilitation and improvement will lead to improved service delivery and will make water available to a majority of Kisumu residents. Issues to do with encroachment of treatment plant land were also raised by those consulted. A lot of developments have been noted to be implemented within the project area and this may starve the project of area for expansion. This is informed by the fact that Kisumu is a growing city and there may be need to expand water treatment plant in future. Issue of projects mushrooming around the intake area was also indicated as a probable cause of adverse impacts. The various land uses may release contaminated wastewater into the lake thus polluting water around their areas of operation. Those consulted are of the opinion that a buffer area should be formed around the facilities beyond which no developments should be allowed. Stakeholders consulted did not associate project construction with significant adverse impacts. Table 8.1 below gives a summary of responses of stakeholders consulted during the study. List of stakeholders consulted has been annexed in Annex 3 of this Project Report.

Table 8.1:List of stakeholders consulted durind ESIA and their responses

No	Name	Phone No.	ID Number	Area	Comment
1	Maurice Onyango	0757563735	24774127	Milimani	The project will create more jobs.
2	Edwin Omondi	0742464377	35565902	Milimani	Water quality will be improved.
3	Benard Omondi	0797369167	30502567	Milimani	The standard of the noisy machines should be improved.
4	Samson Juma	0704556396	10384396	Tom Mboya	The project will improve water quality and create job opportunities.
5	Geoffrey N. Oking	0795822037	277584885	Milimani	The treatment plant should be expanded.
6	Joseph Ndati Ondoro	0702761666	786198	Nanga	Seek prior consent from land owners to mitigate likely challenges during the project.
7	Sebastija Olenge	0700699234	9181685	Milimani	Fresh water will be available for

					the community.
8	Andrew Dache Owiti	0711864403	12706472	Milimani	The agency should reward the community by providing essential services.
9	Kennedy Omondi Ndati	0795333829	25174796	Nyalenda A	The project will help the community.
10	Felix Ochieng	0704373075	24987672	Milimani	The project should be well executed to limit interferences with normal operations.
11	Hulda Achieng	0707820275	30952735	Milimani	The community members should be given first priority when allocating jobs during the implementation of the project.
12	Levis Atinga	0797163004	35351652	Milimani	The project will create more job opportunities.
13	Keegan Loius Onim Otieno	0701586091	33294781	Nyalenda A	Complaints that will arise during the project should be given timely response.
14	Erick Odhiambo	0769896981	36977611	Dunga	The project will create job opportunities and increase access to safe water.
15	Collins Ochieng Otieno	0718249588	25729643	Milimani	The agency should give back to the community through Corporate Social Responsibility initiatives.
16	Wilfrida Owiti	0111713513	2636799	Milimani	The project will improve livelihoods of the community members.
17	Mary Akinyi	0798547269	0735903	Milimani	The project has numerous benefits to the community.
18	George Okul	0712525953	27129939	Milimani	The project will increase access to clean water and also create job opportunities.
19	Larry Samora Machel	0757204085	28435501	Lower Milimani	The people living around the project areas should be given first priority during labour recruitment.
20	Colin M. Lawrence	0741351019	9181155	Nanga	The agency should step in and stop the pumping of raw sewer into the Lake Victoria.

9. Environmental Management and Monitoring Plan

9.1 INTRODUCTION

The key outcome of the Environmental and Social Impact Assessment (ESIA) process for the proposed construction of Water supply and sanitation infrastructure for Kisumu city is the Environmental and Social Management Plan (ESMP). In real meaning, the ESMP is a mechanism to address the recommended environmental and social mitigation measures. This ESMP is an instrument that will allow LVSWWDA, Kisumu Water and Sanitation Company and other key stakeholders to integrate environmental management measures during implementation, operation and decommissioning phases of the project.

9.1.1 Scope and Objectives of the ESMP

This ESMP focuses on mitigating the impacts identified during the environmental assessment. It is an instrument that will allow the project component and the contractor to integrate environmental management measures during the various phases of the proposed project. This plan is meant to establish measures and procedures to control the identified impacts and monitor progress of implementation of the recommended mitigation measures. It will achieve the following in the long run:

- Provide the National Environment Management Authority (NEMA) with a tool to make easy the evaluation of the implementation status of commitments made by the proponent during ESIA study phase;
- Provide clear and mandatory instructions to the contractor with regard to their environmental and social responsibilities during project implementation phase;
- Ensure continuous compliance of the contractor with Kenyan legislation and policies regarding environment conservation and management;
- Assure the regulators and interested and affected parties the satisfaction of their demands in relation to environmental and social performance of the project;
- Ensure that adequate financial and human resources are allocated to the project in order to give effect to such requirements or commitments, and to ensure that the scale of ESMP-related interventions is consistent with the significance of identified impacts;
- Provide a coherent and pragmatic framework for the implementation of the requirements, ranging from the formation of structures to administer the implementation, through the roles and responsibilities of the key project role-players, to the auditing and reporting of compliance; and
- Ensure suitably qualified personnel with adequate power of authority are integrated with the various project implementation organisations to timeously identify and render appropriate and proactive corrective actions to unforeseen events or changes in project implementation not considered in the ESIA process.

9.1.2 Application Legislation

The pieces of legislation applicable to this Environmental and Social Management Plan are described in Chapter five of this Study Report. International normative instruments concerning the environment, as well as international best practice have also been considered.

9.2 ORGANISATION STRUCTURE, ROLES AND RESPONSIBILITIES

The organisational structure identifies and defines the responsibilities and authority of the various role-players (individuals and organisations) involved in the project. The key role-players for the

project are LVSWWDA, the Engineer, the Contractor and the Contractor's Environmental and Social Management Team. The organisational structure has been developed to ensure that there are clear channels of communication; there is an explicit organisational hierarchy for the project; and potential conflicting or contradictory instructions are avoided. All instructions and official communications regarding environmental matters shall follow the organisational structure as determined by this ESMP. In terms of the recommended organisational structure, all instructions that relate to environmental matters shall be communicated to the Contractor via the Engineer's Representative. The only exception to this rule would be in an emergency (defined as a situation requiring immediate action and where failure to intervene timeously would, in the reasonable opinion of the Contractor's Environmental Specialist (or equivalent), result in unacceptable environmental degradation), where instructions may be given directly to the Contractor. The detailed roles and responsibilities of the various role-players identified in the organisational structure are described in the section below. Whatever the structure adopted, it is essential that the responsibilities outlined are assigned to specific parties with the capacity and experience required to implement the ESMP.

9.2.1 The Client

The Client (LVSWWDA) is the holder of authorisations issued by the relevant environmental regulating authorities responsible for authorising and enforcing environmental compliance. The Client, either directly or through Supervising Consultant will ensure that all project operations are conducted in accordance with the applicable environmental regulations and in accordance with this ESMP. The Client will ensure that the ESMP and other requirements related to health, safety and environment are implemented in full. To achieve this objective, the Client and/or through the Supervising Consultant will:

- Request the contractor to operate on the basis of valid authorizations/approvals/ licenses for all activities to be implemented by the contractor;
- Ensure that the various project activities comply with the mitigation measures proposed in this Environmental and Social Management Plan (ESMP);
- Ensure that there are contingency plans and resources for employees health and contingency plans to respond to accidents at work (emergency response plan);
- Make regular inspections to the different activities with regard to social aspects, health, safety and environment and check for any non-conformity with the ESMP attributable to the Contractor and identify the steps taken for its correction;
- Approve work procedures established for each phase of the project and ensure that proposed activities are implemented in accordance with the approved plans;
- Establish and implement a complaints management procedure that allows treatment/appropriate response to them;
- Ensure that any corrective activities recommended by audits or inspections (performed internally or externally) are implemented within the recommended timelines.

9.2.2 The Engineer

The Engineer will be appointed by, and act for, the Client as the Client's on-site implementing agent and shall carry the responsibility to ensure that the contractor undertakes its construction activities in such a way that the Client's environmental responsibilities are not compromised. The Engineer will be responsible for issuing instructions to the Contractor's Environmental Specialist where environmental considerations call for action to be taken. If in the opinion of the Engineer, the Contractor's Environmental Specialist is not fulfilling his/her duties in terms of this ESMP, the Engineer may, after discussion and agreement with the Contractor and Client exercise his powers under general conditions of contract and instruct replacement of the Environmental Specialist in writing and with stated reasons.

9.2.3 The Contractor

The contractor will be responsible for project delivery in accordance with the prescribed specifications, among which this ESMP shall be included. The contractor shall receive and implement any instruction issued by the Engineer relating to compliance with the ESMP.

Compliance with the provisions contained herein or any condition imposed by environmental approvals shall become the responsibility of the contractor through an approved Designated/Dedicated Environmental Officer (DEO). The contractor shall nominate a person from among his site personnel to fulfill this function and submit to the engineer the curriculum vitae of the proposed DEO. Among many tasks, the contractors shall:

- Prepare Construction Environmental and Social Management Plan within thirty days of signing the contract and submit the same to the Client for approval;
- Submit to the proponent work procedures/methods or equivalent documents for approval;
- Operate on the basis of valid licenses/approvals/authorizations for site activities;
- Employ techniques, practices and construction methods to ensure compliance with this ESMP;
- Prevent or minimize the occurrence of accidents/incidents which might cause damage to the environment and be able to respond positively to an accident/incident if it occurs;
- Meet the working procedures and environmental and health and safety requirements established by contract with the Client; ensure compliance with them by sub-contractors who might be hired by him;
- Minimize environmental damage, avoid pollution, prevent loss or damage on any private property or natural resources and minimize project negative effects on the users and occupants of surrounding lands and the public;
- Provide Personal Protective Equipment (PPE) to workers which is appropriate to the tasks to be performed and ensure that they are used at all times;
- Implement all corrective activities agreed in audit (internal or performed by other agencies) or inspections, within the pre- established deadline;
- Manage the complaints process on the elements that fall within their jurisdiction, or refer complaints to the Client, so that they can receive treatment/appropriate response;
- Prepare a rehabilitation plan which shall include preliminary designs on the temporary and permanent restoration plan during both the construction and post-construction/operation periods).

9.2.4 The Designated/Dedicated Environmental Officer (DEO)

Once a nominated representative of the contractor has been approved, he/she shall become the DEO and shall be the person responsible for ensuring that the provisions of this ESMP are complied with during construction phase of the project. The DEO shall submit regular written reports to the Engineer, but not less frequently than once a month. As a minimum, the DEO shall have Bachelor's Degree in environmental or natural sciences or equivalent and have a minimum of 2 years' experience in the environmental regulatory field in construction. The DEO shall monitor implementation of construction ESMP and ensure the Contractor's compliance with the Project's environmental performance requirements during construction phase of the project. The duties shall include:

- Sampling, analysis and statistical evaluation of monitoring parameters with reference to the ESIA study report recommendations and requirements and the construction ESMP;
- Environmental site inspections;
- Audit of compliance with the environmental protection and pollution prevention and control regulations;
- Monitor the implementation of environmental mitigation measures;
- Monitor the compliance with the environmental protection clauses / specifications in the Contract;
- Investigate and evaluate complaints and identify corrective measures;
- Liaise with the Environmental Control Officer (ECO) on all environmental performance matters and timely submission of all relevant environmental monitoring reports;

- Advice the Contractor on environmental improvement, awareness, enhancement matters, etc. on site; and
- Modify construction ESMP and monitoring programme in consultation with the Engineer and ECO if necessary throughout the period of works.

9.2.5 Environmental Control Officer (ECO)

The main duty of the ECO will be to carry out environmental, health and safety (EHS) monitoring of the construction process which shall include, inter alia, the following:

- Objectively and regularly monitoring the contractor's implementation of Construction Environmental and Social Management Plans (C-ESMPs) and NEMA Licence conditions;
- Audit the overall EHS management and monitoring programme including the implementation of all environmental mitigation measures, submissions relating to EHS management and monitoring and any other submission required under NEMA and DOSHS licences;
- Validate and confirm the accuracy of the monitoring results, monitoring procedures and locations of sensitive receivers;
- Conduct random site inspections during construction period;
- Arrange and conduct monthly general site inspections of work sites during the construction period;
- Carry out random sample check and audit on monitoring data and sampling procedures;
- Ensure the impact monitoring is conducted according to the prescribed schedule at the correct locations as identified in the monitoring document;
- Audit the Environmental and Social Impact (ESIA) recommendations and requirements against the status of implementation of environmental protection measures on site;
- Review the effectiveness of EHS mitigation measures and project EHS performance;
- Verify the investigation results of complaint cases and the effectiveness of corrective measures;
- Review and audit in an independent, objective and professional manner all aspects of the EHS management and monitoring programme;
- Feedback audit results to the Engineer according to construction environmental management plan and environmental monitoring document;
- Verify and certify reports prepared by the contractor before submission to regulatory authorities; and
- Report the findings of the site inspections and other EHS performance reviews to the Client through preparation of Monthly Progress Reports.

9.2.6 County Public Health Officer

The County Public Health office through Public Health Officers will monitor implementation of environmental management and monitoring plan by carrying out routine inspections on public health issues associated with project construction and operation. The department will carry out routine inspection of contractor's camp to ensure that cleanliness is maintained at all times and requisite waste management infrastructures have been put in place. The department shall also ensure that food handlers associated with the project have undergone requisite tests and issued with requisite certification to handle food.

9.2.7 Directorate of Occupational Safety and Health Services (DOSHS)

The directorate will monitor implementation of safety and health systems as stipulated in OSHA 2007 by commissioning routine health and safety audits and fire safety audits. The audits will form significant components of monitoring process. The directorate shall also issue workplace registration certificate to the contractor's camp.

9.2.8 Water Resources Authority (WRA)

The Water Resources Authority under their pollution control mandate shall carry out routine water sampling for analysis during operation phase of the project to ascertain pollution levels. Physical/chemical and bacteriological parameters of the water shall be tested. Effluent sampling for analysis shall also be carried out by the authority. Physical/Chemical analysis shall involve tests of physical parameters such as conductivity, pH and tests to establish chemical content for water that is used for domestic purposes. Bacteriological analysis shall involve tests to establish the bacterial content in water. Such tests shall include Fecal Coliforms, E-coli, Residual Chlorine, Chlorine Demand, and Salmonella. The tests shall be carried out to determine suitability of water for drinking and shall target water at the treatment plant and customer drawing points.

9.2.9 External Auditor

An external auditor shall be retained to carry out routine environmental, health and safety and fire safety audit and environmental measurements and tests during construction phase of the project. The auditor will work in partnership with the contractor and supervising consultant and shall carry out requisite audits at the contractor's camp and also carry out noise level and air quality tests. The Tables below provide summaries of the environmental and social management plans for the project:

Table 9.1: Environmental and Social Management Plan

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
1	Site selection	Occupational injuries	Provide on-site first aid facilities for use by employees.	Contractor's Health and Safety Officer	100,000.00
2	Site clearance	Occupational injuries	(i) Regularly administer toolbox talks	Contractor's Health and Safety Officer	Use internal capacity
			(ii) Provide all workers with requisite PPEs	Contractor's Health and Safety Officer	200,000.00
		Dust pollution	Restrict speed of vehicles to 25km/h along haul roads	Contractor's Health and Safety Officer	Nil- Standard Best Practice
		Biodiversity impacts	Vegetation clearance should be restricted to within project alignment areas	Contractor's Designated Environment Officer	Nil- Standard Best Practice
3	Top soil removal	Dust pollution	(i) Covering haul trucks with tarpaulin to avoid material spillage	Contractor's Designated Environment Officer	150,000.00
			(ii) Speed along haul roads will be limited to 25km/h	Contractor's Designated Environment Officer	Nil- Standard Best Practice
		Emissions in the form of NO_X, SO_2 and hydrocarbons due to combustion of fuel	(i) Drivers to switch off trucks when not in operation to reduce hydrocarbon emissions.	Contractor's Construction Supervisor	Nil- Standard Best Practice
			(ii) Construction machinery to be regularly serviced	Mechanic	Construction costs
		Occupational injuries	(i) Provide construction workers with requisite PPEs including helmets, hand gloves, high visibility clothing and safety shoes	Contractor's Health and Safety Officer	As per site clearance.
			(ii) Provide appropriate induction, instruction, and training to all staff	Contractor's Health and Safety Officer/ Contractor's Designated Environment Officer and Sociologist	Use internal capacity
			(iii) Regularly administer toolbox talks	Contractor's Health and Safety Officer	Use internal capacity
4	Demolition works	Noise pollution	(i) Provide all workers exposed to extreme noise conditions with requisite PPEs	Contractor's Health and Safety Officer	As per site clearance
			(ii) Use of personal protective	Contractor's Health and	Construction costs

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
			equipments/devices such as ear-muffs, ear plugs etc. will be strictly enforced for the workers engaged in high noise areas	Safety Officer	
			(iii) Periodical monitoring of noise levels will be carried out	Contractor's Designated Environment Officer	50,000.00
			(iv) Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce generation of noise	Contractor's Mechanic	Construction costs
			(v) Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions	Contractor's Mechanic	Construction costs
5	Excavation works	Dust pollutions	Construction workers to be provided with dust masks as mitigation against dust pollution	Contractor's Health and Safety Officer	As per site clearance
		Noise pollution	(i) The compressors shall be provided with acoustic enclosures as prescribed to reduce the noise levels	Contractor's Health and Safety Officer	Construction costs
			(ii) All vehicles and machinery will be properly lubricated and maintained regularly	Contractor's Mechanic	Construction costs
			(iii) Use of personal protective equipments/devices such as ear-muffs, ear plugs etc. will be strictly enforced for the workers engaged in high noise areas	Contractor's Health and Safety Officer	As per site clearance
			(iv) Periodical monitoring of noise will be done	Contractor's Designated Environment Officer	Use internal capacity

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
			(v) Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce generation of noise	Contractor's Mechanic	Use internal capacity
			(vi) Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions	Contractor's Mechanic	Construction costs
		Land scarification	(i) All excavations shall be carried out within project alignment areas	Contractor's Construction Supervisor	Nil- Standard Best Practice
			(ii) All pits created as a result of excavations for works shall be backfilled and the site restored to pre project condition	Contractor's Designated Environment Officer	Construction costs
		Spoil generation as a result of excavation works	All spoil generated as a result of excavation works shall be used to backfill the excavated areas and for restoration of disturbed sites within the work areas.	Contractor's Designated Environment Officer	Nil- Standard Best Practice
		Occupational injuries	(i) Provide on-site first aid facilities at the site for use by employees	Contractor's Health and Safety Officer	As per site selection
			(ii) Fence off work sites to mitigate access by non-construction workers	Contractor's Project Manager	As per top soil removal
			(iii) All staff will be provided with safety shoes, helmets, ear muffs, gas masks, etc.	Contractor's Health and Safety Officer	As per site clearance
			(iv) Appropriate induction, instruction, and training shall be provided to all workers	Contractor's Health and Safety Officer/ Contractor's Designated Environment Officer and Sociologist	Use internal capacity

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
6	Backfilling works	Occupational injuries	(i) Provide all workers with requisite PPEs	Contractor's Health and Safety Officer	As per site clearance
			(ii) Excavated trenches should be backfilled within 24 hours	Contractor's Construction Supervisor	Construction Costs
			(iii) Only suitably qualified personnel to construction plant, vehicles and machinery.	Contractor's Construction Supervisor	Nil- Standard Best Practice
			(iv) Handling of equipment and materials to be supervised and adequately instructed.	Contractor's Construction Supervisor	Nil- Standard Best Practice
			(v) Tool box talks to be regularly administered	Contractor's Health and Safety Officer	Use internal capacity
			(vi) Staff to be appropriately inducted and regularly trained on ESHS matters	Contractor's Health and Safety Officer/ Contractor's Designated Environment Officer and Sociologist	Use internal capacity
7	Disposal of excess materials and spoils	Noise pollution	Proper maintenance, oiling and greasing of machines at regular intervals to reduce generation of noise	Contractor's Mechanic	Construction costs
		Dust pollution	Sprinkle water of road surfaces to suppress dust	Contractor's Designated Environment Officer	As per mining of hard stones
		Occupational injuries	Provide all workers with requisite PPEs	Contractor's Health and Safety Officer	As per site clearance
		Community Safety issues	Erect speed signs along haul roads	Contractor's Health and Safety Officer	Use internal capacity
			Use services of traffic marshalls at road intersections	Contractor's Health and Safety Officer	Use internal capacity
8	Compaction	Noise pollution	Proper maintenance, oiling and greasing of machines at regular intervals to reduce generation of noise	Contractor's Mechanic	Construction costs
		Dust pollution	Sprinkle water of road surfaces to suppress dust	Contractor's Designated Environment Officer	As per mining of hard stones
		Occupational injuries	Provide all workers with requisite PPEs	Contractor's Health and Safety Officer	As per site clearance
9	Surface	Noise pollution	Proper maintenance,	Contractor's	Construction

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
	reinstatement and restorations	from construction machinery	oiling and greasing of machines at regular intervals will be done to reduce generation of noise;	Mechanic	costs
		Dust pollution due to surface disturbance	Speed of the Vehicles entering and leaving the quarrying lease will be limited to 25 kmph	Contractor's Health and Safety Officer	Nil- Standard best Practice
10	Operation Impacts	Solid wastes from water treatment system	(i) Minimize the quantity of solids generated by the water treatment process through optimizing coagulation processes	KIWASCO	Operation Costs
			(ii) Dispose of sludge by land application at a solid waste disposal site approved by the local authority and in compliance with Solid Waste Regulations 2006.	KIWASCO	Operation Costs
		Wastewater discharge from the treatment process	(i) Land application of wastes with high dissolved solids concentrations is generally preferred over discharge to surface water	KIWASCO	Operation Costs
			(ii) Treat and dispose of reject streams, consistent with national and local requirements.	KIWASCO	Operation Costs
		Exposure to hazardous chemicals used in the water treatment process	(i) Minimize the amount of chlorination chemicals stored on site while maintaining a sufficient inventory to cover intermittent disruptions in supply	KIWASCO	Operation Costs
			(ii) Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident	KIWASCO	Operation Costs

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
			investigation procedures		
			(iii) Develop and implement a plan for responding to accidental releases.	KIWASCO	Operation Costs
		Contamination of water from natural sources at the intake works	(i) Identify potential sources of contamination within the headworks and collaborate with local authorities in the implementation of management approaches to protect the source water quality	KIWASCO	Operation Costs
			(ii) Continuously monitor raw water for surrogate parameters (such as pH, conductivity, total organic carbon [TOC], and toxicity)	KIWASCO	Operation Costs
			(iii) Inspect sites at random times	KIWASCO	Operation Costs
		Contamination of drinking water from treatment operations	(i) Install alarm and safety systems, including automatic shutoff valves that are automatically activated when a chlorine release is detected;		Operation Costs
			(ii) Use corrosion-resistant piping, valves, metering equipment, and any other equipment coming in contact with chlorine, and keep this equipment free from contaminants, including oil and grease;	KIWASCO	Operation Costs
			(iii) Construct, operate and maintain the water treatment facility in accordance with national requirements and internationally accepted standards to meet national water quality standards and	KIWASCO	Operation Costs

No.	Activity	Impact	Mitigation Measure	Responsibility	Estimated Cost (Kshs)
			WHO Guidelines for Drinking Water Quality ;		
			(iv) Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures	KIWASCO	Operation Costs
		Exposure of water to pathogens from storage facilities and from external sources	Construct, operate, and manage the water distribution system in accordance with applicable national requirements and internationally accepted standards	KIWASCO	Operation Costs
Total					**500,000.00**

9.3 ENVIRONMENTAL MONITORING AND AUDIT (EM&A)

9.3.1 Purpose of the Environmental Monitoring and Audit

Environmental Monitoring and Audit (EM&A) will be carried out during construction and operation phases of the project to ensure effective implementation of mitigation measures recommended in the Environmental and Social Impact Assessment (ESIA) report, and relevant environmental protection and pollution prevention and control legislations. The EM&A programme will be used to assess the effectiveness of, inter alia, the implementation of the recommended mitigation measures, and to identify any further need for additional mitigation measures or remedial actions. Monitoring and audit during construction stage aims to provide systematic procedures for monitoring, auditing and minimizing the environmental impacts associated with construction works. Findings, recommendations and requirements of the ESIA; all relevant requirements under the Environmental Management and Coordination Act (EMCA) 1999 and other environmental legislations; and the Kenyan planning standards and laws have been adopted in these monitoring and audit procedures.

9.3.2 Reporting Procedures during Construction stage

During construction, the contractor will supply regular progress reports (weekly and monthly as appropriate) to the Engineer (the Supervision Consultant) covering all aspects of the Works. The progress reports will include data and information on health and safety (accidents and incidents), environmental protection (spill and non-compliance), labour (numbers, grades, problems), community relations (complaints, issues), and relevant training. The supervision consultant will check the contractor's reports and forward them to the Employer (LVSWWDA), including any additional records concerning implementation of the project's Environmental and Social Management Plan (ESMP). It is recommended that the Contractor's staff on site shall establish and maintain effective communication links with relevant agencies including local administration, National Environment Management Authority (NEMA) and Directorate of Occupational Safety and Health Services (DOSHS) to ensure easy two-way flow of information.

9.3.3 Auditing

Auditing of ESMP implementation and/or effectiveness also requires external specialist skills. These could be provided by highly experienced and independent specialists. It is hereby recommended that an external auditor shall be retained by the contractor to carry out routine environmental, health & safety and fire safety audits for various project components during construction phase of the project. Measurement of environmental parameters including noise and vibration levels, dust levels and water quality among others shall form part of this audit.

9.3.4 Parameters to Monitor

Parameters associated with the project and which will be monitored during construction phase are summarised in the Table 9.2 below. They include among others: Compliance with regulatory requirements; awareness and training; safety and health management; air quality -construction, batching and quarry dust; noise Impact- construction and blasting noise (as applicable); water quality; waste generation including storage and disposal; conditions of biological environment; and employment HIV/AIDS and gender issues.

9.4 MONITORING METHODOLOGY

9.4.1 Air Quality

During project construction phase, dust monitoring program will focus on Total Suspended Particulates (TSP) and dust deposition. The sampling locations and frequency will be established before the onset of construction. Baseline monitoring shall be completed before the construction work commences. Impact monitoring shall be conducted whenever there is dust generating activity going on at the site. Regular site audits shall also be carried out by the contractor's Designated Environmental Officer (DEO) and independent audits carried out annually by an external auditor to check for compliance with air quality standards by the project.

9.4.2 Noise Pollution

Potential noise impacts shall emanate from construction activities during project implementation. Noise monitoring shall be carried out to ensure that mitigation measures contained in Construction Environmental and Social Management Plan (C- ESMP) are timeously implemented and that the noise sensitive receivers are effectively protected. Baseline monitoring shall be completed before noise producing activities commences. Impact monitoring shall be conducted whenever there is implementation of any noise generating activity at the site. Permitted Noise Level (Leq) in dB (A) shall be recorded.

9.4.3 Water Quality Monitoring

Water quality is one of the main indicators of the quality of service provided to the consumer. Water quality has an impact on both the public health and aesthetic value of water as a consumable product. For effective monitoring of water quality, both internal self-monitoring by the contractor and an independent monitoring by an external laboratory will be put in place. External monitoring shall be carried out by NEMA-accredited laboratory.

9.4.4 Waste Management

Waste monitoring will be carried out during construction process. Monitoring of each waste stream shall be carried out periodically to determine if wastes are being managed in accordance with approved procedures and the Construction Waste Management Plan (CWMP). The audits shall cover all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. The general site inspections will be undertaken weekly by Supervision Consultants Environmental Team to check all construction activities for compliance with all appropriate environmental protection and pollution control measures, including those set up in the CWMP.

9.4.5 Conditions of Biological Environment

Monitoring of biological environment within the project area will be carried out to ensure that project activities like site clearance and stripping of top soil do not adversely affect biological environment. The monitoring will be carried out by the Supervision Consultant's personnel.

9.4.6 Labour, Employment, HIV/AIDS Issues

The key issues to be monitored during construction phase include labour relations, employment of local labour, HIV/AIDS awareness, gender relations and underage employment among others.

Table 9.2: Monitoring Framework for Environment, Health, Safety and Social Issues

Main Issues/ Impacts	Parameters to monitor	Monitoring Indicators	Monitoring Methods	Frequency of monitoring	Responsibility for monitoring
Compliance with Regulatory requirements	Operation licences and permits	NEMA licence for project construction, contractor camps, quarry sites, borrow sites and crushing plant in place	Review of records	Monthly	Supervision Consultant
		Blasting permit from Mines and Geology Department in place	Review of records	Monthly	Supervision Consultant
		Health certificates for food handlers in place	Review of records	Monthly	Supervision Consultant
	Audit reports	Health and Safety, Fire Safety, Environmental Audit and Risk Assessment reports available	Document Review	Monthly	Supervision Consultant
Training and awareness on environmental, health and safety issues	Induction training on Environment, health and safety issues	List of staff trained	Review of records	Monthly	Supervision Consultant
		Signed attendance list	Review of records	Monthly	Supervision Consultant
	Staff training on health and safety	List of staff trained	Review of records	Monthly	Supervision Consultant
		Signed attendance list	Review of records	Monthly	Supervision Consultant
	Staff training on environmental issues	List of staff trained	Review of records	Monthly	Supervision Consultant
		Signed attendance list	Review of records	Monthly	Supervision Consultant
	Staff training on fire safety	List of staff trained	Review of records	Monthly	Supervision Consultant
		Signed attendance list	Review of records	Monthly	Supervision Consultant
Human Resource Management	Environment, Health Safety and Social personnel	Health and Safety Officer available	Review of records	Monthly	Supervision Consultant
		Designated Environment Officer (DEO) available	Review of records	Monthly	Supervision Consultant
		Community Liaison Officer (Sociologist) available	Review of records	Monthly	Supervision Consultant
Relationship with local community	Complaints and grievances	Number of grievances lodged	Review of records	Monthly	Supervision Consultant
		Number of grievances redressed	Review of records	Monthly	Supervision Consultant
	Grievance Redress Mechanism	Grievance Redress Plan in place	Review of records	Monthly	Supervision Consultant
		Grievance Redress Forms in place	Review of records	Monthly	Supervision Consultant
		Grievance register in place	Review of record	Monthly	Supervision Consultant
Occupational Health and Safety issues	Health and Safety Management	Work Health and Safety Plan in place	Review of records	Monthly	Supervision Consultant
		First Aid kits available on site	Periodic checks	Monthly	Supervision Consultant
		Number of condom dispensers loaded with male condoms	Periodic checks	Monthly	Supervision Consultant

Main Issues/ Impacts	Parameters to monitor	Monitoring Indicators	Monitoring Methods	Frequency of monitoring	Responsibility for monitoring
		Number of toilets available on site	Periodic checks	Monthly	Supervision Consultant
	Health and safety committee in place	Minutes of committee meetings	Review of records	Monthly	Supervision Consultant
		Attendance list of committee meetings	Review of records	Monthly	Supervision Consultant
	Provision of Personal Protective Equipment (PPE)	Number of workers provided with safety shoes	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with helmets	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with reflective jackets	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with eye shield	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with nose masks	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with hand gloves	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with overalls	Periodic checks	Daily	Supervision Consultant
		Number of workers provided with nose masks	Periodic checks	Daily	Supervision Consultant
	Occurrence of Accidents and incidents	Accident/ Incident forms available	Review of records	Monthly	Supervision Consultant
		Number of injuries reported	Review of records	Monthly	Supervision Consultant
		Number of off days due to injuries	Review of records	Monthly	Supervision Consultant
		Number of injury related treatments	Review of record	Monthly	Supervision Consultant
		Number of compensations launched	Review of records	Monthly	Supervision Consultant
Consultations and meetings	Number of community meetings, Health and Safety Committee meetings and Grievance Redress Committee (GRC) meetings held	Meeting schedules	Review of records	Monthly	Supervision Consultant
		Attendance list of participants	Review of records	Monthly	Supervision Consultant
		Minutes of meetings	Review of records	Monthly	Supervision Consultant
Traffic related issues	Construction traffic management	Traffic Management Plan in place	Review of records	Monthly	Supervision Consultant
		Traffic signs in place	Random checks	Weekly	Supervision Consultant

Main Issues/ Impacts	Parameters to monitor	Monitoring Indicators	Monitoring Methods	Frequency of monitoring	Responsibility for monitoring
		Speed limits in place	Random checks	Weekly	Supervision Consultant
		Traffic diversion signs in place	Random checks	Weekly	Supervision Consultant
Labour, employment, gender and HIV/AIDS	Labour and employment management	Labour and working conditions plan in place	Review of records	One off	Supervision Consultant
		Number of employees who have signed code of conduct	Review of records	Monthly	Supervision Consultant
	Compliance with labour laws	Number of underage workers employed	Random checks	Daily	Supervision Consultant
		Number of workers with employment contracts	Review of records	Monthly	Supervision Consultant
	HIV/AIDS awareness	HIV/AIDS awareness Plan in place	One off	Monthly	Supervision Consultant
		List of staff	Review of records	Monthly	Supervision Consultant
		Attendance list	Review of records	Monthly	Supervision Consultant
Record keeping	Presence of records of site activities	Filled in Designated Environment Officer (DEO) diary	Review of records	Monthly	Supervision Consultant
Water quality	Chemical components	Temperature, pH, Conductivity, dissolved Oxygen, Nitrates, Alkalinity, Total suspended solids, Total dissolved solids	Sampling for analysis in NEMA accredited laboratories	Quarterly	Contractor
			Sampling for analysis in NEMA accredited laboratories	Annually	External NEMA licensed Expert
	Bacteriological components	Total coliforms per 100ml, Feacal coliforms per 100ml	Sampling for analysis in NEMA accredited laboratories	Quarterly	Contractor
			Sampling for analysis in NEMA accredited laboratories	Quarterly	External NEMA licensed Expert
Noise impacts	Noise pollution	Noise levels in Db (A)	Onsite measurement and analysis using noise meter	Weekly	Contractor
			Onsite measurement and analysis using noise meters	Annually	External NEMA licensed Expert
Emission impacts	Air quality	Sulphur Oxides (SO_X), Oxides of Nitrogen, (NO_X), Carbon Dioxide (CO_2), Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM)	Onsite analysis of environmental parameters	Monthly	Contractor
			Onsite analysis of environmental	Annually	External NEMA licensed Expert

Main Issues/ Impacts	Parameters to monitor	Monitoring Indicators	Monitoring Methods	Frequency of monitoring	Responsibility for monitoring
		(<10µm), $PM_{2.5}$, Nitrogen Dioxide	parameters		
Waste management	Solid and hazardous waste management infrastructure	Waste Management Plan in place	Review of records	Monthly	Supervision Consultant
		Waste collection bins in place	Inspections	Monthly	Supervision Consultant
		Weather proof waste storage area in place	Inspections	Monthly	Supervision Consultant
		Contract with NEMA-licensed solid waste handler in place	Review of records	Monthly	Supervision Consultant
		NEMA licence for solid waste handler available	Review of records	Monthly	Supervision Consultant
Soil erosion	Quantity of soil eroded	Gulleys within the construction site, silt deposits within the area and turbidity of water in local water bodies	Observation during field inspections	Weekly	Supervision Consultant
Bush clearance	Trees and vegetation removal	Number of trees destroyed	Tree census	Monthly	Supervision Consultant
		Area cleared	Observation during site inspection	Monthly	Supervision Consultant

10. DECOMMISSIONING

10.1 INTRODUCTION

Decommissioning normally takes place both at the end of construction period and during the final phase of a project life-cycle. Environmental planning is therefore necessary before any decommissioning activities should be allowed to commence. The reason for this is because a project earmarked for decommissioning has in all likelihood been operational for some time, and as such, the environment within which it lies has stabilised in response to the presence of the associated infrastructure, activities and facilities. At the end of construction phase, decommissioning mainly targets temporary facilities associated with construction camps and site restorations. The decommissioning of one or all components of the proposed project will therefore have some effect on the environmental status quo of the project site, either in a positive or in a negative way. This section contains various environmental guidelines which will assist decision makers to take environmentally responsible and sustainable decisions in terms of which infrastructure to retain, which to develop further (and how to do this), and which to remove completely in so far as construction and operations of this project are concerned. In this way, the positive aspects of decommissioning may be maximized and the negative aspects minimized or even avoided.

10.2 PURPOSE AND OBJECTIVE OF DECOMMISSINING

The generally accepted purpose of decommissioning is the release of valuable assets such as machinery and sites for alternative use, recycling and reuse of materials and the restoration of environmental amenity. In all cases, the basic objective is to achieve an end-point that is sensible in technical, social and financial terms, that properly protects workers, the public and the environment and, in summary, complies with the basic principles of sustainable development. Stringent regulatory controls protect the public, the environment and workers from the hazards associated with decommissioning activities.

10.3 DECOMMISSIONING AT THE END OF CONSTRUCTION PHASE

The construction process for the proposed project site will involve a number of activities which may contribute to some changes in the local environmental conditions. The decommissioning exercise will involve dismantling of site facilities; backfilling all disturbed areas and transportation of materials out of site for disposal or re- use in similar future projects. Materials from the site will be basically remains from construction activities and include scrap metals and plastic pipes among others. These materials can be reused, recycled and donated to other organizations. Scrap materials, can often be reused or refurbished. Some items could be used by the proponent for their next job, and many items can be sold to used - materials stores, scrap recyclers, waste exchanges or other outlets. Various items shall be accumulated separately to facilitate recycling. The table below gives a summary of mitigation measures proposed for decommissioning during construction stage.

Table 10.1: Decommissioning at the end of Construction Phase

Issue	Action Required	Responsibility
Impacts related to procurement of construction materials	Close all borrow pits in accordance with an approved plan to maximise future use and minimise health and safety hazards.	Contractor
Solid waste arising from construction activities	The site is to be cleared of all construction materials, including litter prior to hand over	Contractor, LVSWWDA, KIWASCO
Fences, barriers and demarcations	Fences, barriers and demarcations associated with the construction phase must be removed from the site	Contractor
Disturbed areas	The site must be fully rehabilitated and stabilised (for	Contractor

	example, through revegetation)	
Contractor camp	Decommission all contractor camp services including electricity, water and sanitation facilities	Contractor
Site remediation	A meeting must be held on site between the Engineer, Environmentalist and the Contractor to approve all remediation activities and ensure that the site has been restored to a condition approved by the Engineer	Contractor and supervising consultant
Hazard to workers	(i) Implement full H&S programme (Health and Safety Plan) and labour welfare provisions. (ii) Establish and operate an emergency evacuation procedure for casualties.	Contractor
Environmental cases identified	Rehabilitation Activities of Environmental Cases identified must continue throughout the defect liability period	Contractor and supervising consultant

10.4 DECOMMISSIONING DURING THE FINAL PHASE OF THE PROJECT

Decommissioning of the project infrastructure is anticipated to be after the end of design life of the water supply and sanitation infrastructure. During decommissioning, the following steps should be considered in order to undertake the procedure in a structured manner.

Table 10.2: Decommissioning during the Final Phase of the Project

Step	Activity	Actions required	Responsible party
Step 1	Initiation	• Development of an objective worksheet and checklist incorporating references, legal and policies	Proponent
Step 2	Prepare road map for decommissioning design	• Conduct design review to validate elements of the design and ensure design features are incorporated in the decommissioning design. • Carry out public consultations	Proponent
Step 3	Prepare and award contract	• Prepare a contract that incorporates validated project information and award to a contractor as per the procurement rules.	Proponent
Step 4	Implement the project.	• Implement design elements and criteria on the project in accordance with specifications and drawings. • Inspect during decommissioning and at project completion to ensure that all design elements are implemented according to design specifications.	Contractor and proponent
Step 5	Non-conformance, corrective/preventive action	• Determine root cause • Propose corrective measures • Propose future preventive measures.	All responsible

11. Environment, Health and Safety (ESH)

11.1 EHS Management and Administration

The EHS is a broader and holistic aspect of protecting the worker, the workplace, the tools / equipments and the biotic environment. It is an essential tool in determining the ESIA study. The objective of EHS on the proposed project is to develop rules that will regulate environmentally instigated diseases and occupational health and safety issues during construction, operation and decommissioning phases of the proposed project through 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; and enhancing environmental sustainability through developing sound conservation measures.

11.2 Policy, Administrative and Legislative Framework

It is the primary responsibility of the contractor to promote a safe and healthy environment at the workplace and within the project neighbourhood by implementing effective systems to prevent occupational diseases and ill-health, and to prevent damage to property. The EHS Management Plan when completed will be used as a tool and a checklist by project stakeholders in planning and modification of the construction of the proposed project infrastructure. The plan will also provide for the establishment of an appropriate legal and institutional framework for the implementation of EHS in conformity to relevant statutes like; the Public Health Act Cap. 242; Occupational Safety and Health Act (OSHA), 2007; Environmental Management and Co-ordination Act (EMCA) 1999; Workmen Compensation Act Cap. 236 and other accompanying laws and by-laws already mentioned elsewhere in this report

11.3 Organization and implementation of the EHS Management Plan

The contractor(s) shall use the EHS plan at the proposed project site during construction and operation phase of the project with the assistance of EHS personnel who shall enforce its provision throughout the project duration.

11.4 Occupational Health and Safety Management

The proponent shall ensure, so far as is reasonably practicable, the health, safety and welfare at work of his employees including those of his sub-contractors and of all other persons on site. The Contractor shall comply with OSHA 2007, the Public Health Act; the Work injury benefits Act, the Employment Act and other Statutory Regulations, rules and bylaws regarding occupational health, safety and gender. The Proponent's responsibilities shall, inter alia, include requirements contained in the sections below.

11.4.1 Safe constructional plant, equipment and methods of work

The proponent and/ or his agents shall provide and maintain project equipment and systems of work that are safe and without risks to health and safety of workers and visitors to the site. This shall include maintaining equipment, engines, and related electrical installations in good working order; maintaining a clean and tidy work space; providing signals; providing work site rules, safe working procedures and allocating appropriate places to carry out the work.

11.4.2 Safe handling, storage, transport and disposal

The proponent and/ or his agents shall execute suitable arrangements for ensuring safety and absence of risk to health in connection with the use, handling, storage, transport and disposal of articles and substances. Transportation of any material by the Proponent and/ or his agents shall be in suitable vehicles which when loaded does not cause spillage and all loads shall be suitably

secured. Any vehicle that does not comply with this requirement or any of the local traffic regulations and laws shall be removed from the site. The Proponent and/or his agents must ensure that all stores are located such as to reduce risks to the workers on site. Arrangements for the safe use, handling, storage, transport and disposal of articles and substance are to be made before work commences to the satisfaction of the supervising Engineer.

11.4.3 Protective Clothing, Equipment etc

Provision of protective clothing and equipment, first aid stations with such personnel and equipment as are necessary and such information, instruction, training and supervision as are necessary to ensure the health and safety at work of all persons employed on the works all in accordance with the Laws of Kenya. The Proponent and /or his agents shall provide, at his own expense, protective clothing and safety equipment to all staff and labour engaged on the works to the satisfaction of the supervising Engineer. Such clothing and equipment shall include, at a minimum high visibility vest for workers directing traffic; protective boots and gloves for the workforce operating excavation machines and equipment; protective footwear, gloves, goggles, and dust mask for the workforce at the construction site; and ear protectors and dust mask for the workforce engaged in rock drilling or in using vibrating equipment.

11.4.4 Safety Officer

The Proponent shall designate a qualified Safety Officer (Accident Prevention Officer) from one of his senior staff who has specific knowledge of safety regulations, experience of safety precautions on similar works and who shall advise on all matters affecting the safety of the workforce and on measures to be taken to promote such safety. The Safety Officer shall work full time directly on the project at the project site. He/she might have other obligations in relation to similar topics, e.g. environment, social and/or medical aspects including HIV/AIDS prevention, as long as at least 50% of his/ her time is devoted to Occupational Health and Safety. The Safety Officer shall have specific training in the Proponent's safety and health management system and procedures, practice, etc. and before commencement of the Works, the Safety Officer shall receive training in (or receive a refresher course in) industrial first aid (or the equivalent). The Safety Officer shall routinely provide workers with training in safe work practices and general awareness of potential danger situations to avoid injuries. Trained first aid personnel, transport for sick or injured workers, and a stocked first aid kit shall be available at the site at all times. The Proponent shall establish emergency evacuation procedures to enable a rapid response to accidents.

11.4.5 Safety courses

All employees shall be given training on how to ensure their own personal safety and on ways to reduce the accident risk on those sites where large, mobile heavy vehicles and equipment or equipment with moving parts are in use. The Safety Officer shall provide training in safe work practices and general awareness of potential danger situations to avoid injuries. In addition, all employees handling dangerous/toxic materials shall be trained in how to handle dangerous/toxic materials.

All the Proponent's and contractor’s personnel shall, before starting to work, have an induction course on safety and health at the site. The information and training shall be on the site and have duration of at least two hours. It shall be conducted in English and, if necessary, also in a relevant local language to ensure that all personnel can understand the information and instructions. The Site Manager shall take part in at least the first part of the training. He shall present the Proponent's safety policy and goal, the responsibilities and roles in relation to safety and health of all individuals, and the more specific responsibilities and roles of key staff (Site Manager, Safety Officer, foremen, and others). The topics of the course shall be, but are not limited to:

- Proponent’s/ Contractor’s safety policy and goal;
- Organization of safety and health at work and the responsibilities and roles of the Site Manager, the superintendents/supervisors/foremen, the Safety Officer and of each individual worker;
- Mandatory use of personal protective equipment on the site;
- Specification of the type of equipment, where and when to use it and how it shall be used, stored, cleaned and maintained correct;

- Placement and content of first aid equipment and fire extinguishers;
- Use of fire extinguishers;
- How to use the equipment and information on who are specially trained in first aid and how to contact them;
- How to transport an injured person to a medical doctor or to the hospital;
- Safety rules for the site, e.g. in relation to the use of different equipment, tools, vehicles, fuel, oil, chemicals, explosives and abrasives;
- Cleaning, housekeeping and maintenance of the site, including vehicles, equipment, tools, workshops, houses etc;
- If work permits are required for specific tasks;
- Manual handling, transport, storage and disposal of equipment, goods, etc. in a safe way preventing accidents and too heavy burdens;
- How to ensure that equipment, goods, etc. will not be an obstacle imposing a risk to other persons due to inadequate placement and protection of it;
- Welfare facilities and access to drinking water and water in case of skin burns on the site;
- The use of safety signs and protective barriers;
- Safe use of fuel, oil, chemicals, explosives;
- Prevention of dust generation and exposure;
- Road safety aspects, sign posting and principles and measures for minimising the risk of traffic accidents;
- HIV/AIDS prevention (only an introduction, more information shall be provided within one month of the employment on the site); and
- Consequences of breach of discipline and not complying with rules

Different induction courses can be held for different types of workers ensuring the correct weight on relevant topics, e.g. vehicle operators, work shop workers etc. A Safety booklet written in English (a Swahili version is also recommended) shall spell out the most important aspects of occupational safety and health. The Safety booklet may take its starting point in the Proponent's general description of safety and health, but it shall be very specific for contract works. The safety booklet shall be handed to all staff at the introduction course and used as training material. More training material might be relevant to use at the induction course.

11.4.6 Safe access

The Proponent and his agents shall provide and maintain access to all places on the site in a condition that is safe and without risk of injury.

11.4.7 Latrines and other sanitary arrangements

The Proponent and/ or his agents shall provide an adequate number of suitable latrines and other sanitary arrangements at sites where work is in progress to the satisfaction of the supervising Engineer.

11.4.8 Reporting of accidents

The Proponent and/ or his agents shall report details of any accident to the relevant authorities, if appropriate, as soon as possible after its occurrence.

11.4.9 Occupational health hazards

The Proponent and /or his agents shall reduce occupational health hazards, such as:

- Physical hazards (continuous noise and vibrations, prolonged stay in high temperatures);

- Chemical hazards (exposure to fumes, chemicals and dust including solvents, paints, and exhaust gases);
- Mechanical hazards (unguarded or exposed moving objects and other dangers from the use and operation of machines);
- Risk of accidents with hand tools (slips, falls, eye injuries) heavy items (the accidental dropping of heavy items) and vehicles;
- Thermal hazards (heat stroke from long hours working in direct sunlight and burns due to contact with hot items);
- Electrical, fire or explosion hazards;
- Ergonometric risk factors (personal injuries associated with poor working postures, heavy lifting, repetitive work, repetitive hand arm vibrations, manual transport); and
- Sanitation hazards (including contaminated drinking water, poor food practices, improper waste disposal, unhygienic toilet and washing facilities, contact with solid and/or biological waste).

11.4.10 Means of reducing Occupational health hazards

The means of reducing occupational health hazards shall include:

- Using vibration-reduced and sound-reduced equipment;
- Providing shade at stationary work places and at welfare facilities;
- Having only trained and experienced persons use dangerous chemicals and operate the machines;
- Providing safety awareness training for all workers;
- Providing easily movable equipment to reduce risk of injury associated with heavy lifting or & work;
- Varying job functions (to avoid excessive repetitive motions);
- Providing on the site, throughout working hours, adequate and easily accessible supplies of safe drinking water, access to washing facilities (because of chemical and biological hazards), proper eating places and waste disposal facilities;
- Provide adequate signing, fencing and guards to ensure that unauthorised persons shall be kept off the site. This is especially relevant for the dangerous parts of the site, e.g. the storage areas for oil, fuel, chemicals, machines, the car park, and the work shop, near deep holes, and power lines;
- The Proponent and/ or his agents shall keep the site free from all unnecessary obstructions, and shall store or dispose of any equipment or surplus of materials. The Proponent and/ or his agents shall clear away and remove from the site any wreckage, rubbish and temporary works which are no longer required;
- The Proponent and/ or his agents are responsible for providing safe passage around and through the work site for all kinds of traffic, including non-motorised traffic and pedestrians. Traffic signs, traffic control signals and barriers shall be used for direction and control of traffic and to inform drivers of the importance to slow down and drive carefully;
- Vehicles shall at all times be maintained in accordance with original manufacturer's specifications and service manual. This will ensure low noise generation, low emission of diesel particulate emission and that the vehicle will not result in accidents due to inadequate maintenance. Special inspection and maintenance is required for brakes, steering wheel, light, horn, tyres, oil and water. Seat belts shall be installed and used. All heavy vehicles shall have reverse warning signal. The operators shall be instructed in avoiding spillage, not overturning or overloading and not to drive at too fast speed. Operators shall be protected against the sun and a cabin shall protect against injuries if the vehicle is tipping around; and
- All accidents shall be recorded and analyzed by the proponent and/ or his agents in order to prevent similar accidents in the future. Fatal accidents shall also be reported to the Police. Accident records shall be submitted to the authorities in accordance with applicable regulations.

11.4.11 Monitoring process

The proponent and/or his agents shall by daily inspections monitor:

- The use of specified personal protective equipment;
- The cleanliness of the working area which is to be kept tidy with no unnecessary obstacles;
- Dust generation and exposure and appropriate watering if required;
- The presence of any new workers on the site, or plans to hire in the near future, and therefore need for induction courses;
- The position and adequacy of signing, barriers and fencing; and
- The Safety Officer shall, at least on a monthly basis, monitor all site activities and prepare a report on his findings.

The report shall include:

- Number and type of accidents, and preventive measures implemented to minimise future similar accidents;
- Number of workers who have attended (and not attended) an induction course;
- Number of workers who have received special training because they started on a new work function, and the total number of workers who should have received such training;
- Stock of personal protective equipment and quantities issued;
- Maintenance of the vehicles: tyres, brakes, light, steering wheel, oil, water;
- Condition of first aid equipment in place with quantities and requirements for replenishment; and
- The change in number of workers and their work functions.

11.5 HIV/AIDS AND STI PREVENTION

The Proponent's Management Plan for HIV/AIDS and STI shall include details of the measures he proposes to adopt to combat the spread of HIV/AIDS and sexually transmitted Infections (STI) between his staff, labour and the local community. The plan shall also outline workplace policies and programmes for employees living with HIV/AIDS, information and awareness campaigns and effective screening and counselling policies for STI and HIV/AIDS cases of his project staff. In any case, the Proponent shall comply with the HIV and AIDS Prevention and Control Act (2006) which prohibits discrimination of persons living with HIV and AIDS.

The proponent and/ or his agents will work closely with Kenya National Aids Control Council and MoH to put in place non-discriminatory workplace measures to protect the employees living with HIV/AIDS and to ensure that they are treated and counselled. Prevention measures will also be established to protect others against any risk of illness and injury, which can result in HIV/AIDS infection and transmission.

The Proponent and/ or his agents shall advise all site staff and labour of the danger and impacts of STI's in general and HIV/AIDS in particular. To this end, the Proponent shall conduct information, education and consultation (IEC) campaigns at least every other month, targeting the aforementioned site staff, labour, and the immediate local communities. The Safety Officer or another of the Proponent's staff may carry out the awareness training if qualified; otherwise a person from outside (e.g. from Hospital) may be hired to carry out the awareness training.

11.6 GENDER

The Proponent's Management Plan for Gender shall include description of recruitment policy and procedures, awareness raising meetings, gender sensitive working conditions and facilities to be provided at the workplace, and participatory gender sensitive monitoring of site conditions. The Proponent and/ or his agents shall ensure that recruitment procedures and working conditions and facilities are gender sensitive and in particular that:

- Announcement notices of equal employment opportunities are posted in visible and popular places in the local communities and that such notices also reach women and youth leaders;
- Both men and women are represented in any information and consultative meetings held at the site and that gender and social issues are raised and analyzed;
- Equal payment is made to men and women for similar work and that payment of wages is made to the workers and not to representatives;
- Flexible working hours are introduced to the fullest extent possible to take account of multiple roles of women and cultural norms.; and
- Separate toilets are provided for women, including sanitary facilities and shades for children of working mothers.

12. Conclusions and Recommendations

12.1 CONCLUSIONS

The following conclusions apply to the proposed Dunga Raw Water Intake and Treatment Plant

12.1.1 General

The raw water intake and Dunga Water Treatment Plant have operational deficiencies that need to be fixed if water supply issues are to be adequately addressed in Kisumu City. Since the commissioning of the first raw water pumping station at the Hippo Point, the site has undergone several rehabilitations and upgrading, and now constitutes three separate intakes and related pumping stations. The gradual upgrading of the raw water intake over time has led to a rather cumbersome pumping and piping arrangement that may be linked with potential capacity restrictions. Dunga Water Treatment Plant also has capacity issues that need to be addressed. The facilities have aged over time and worn out parts should be replaced.

12.1.2 Existing Environmental and Social Impacts

A number of social and environmental impacts were noted at the raw water intake and the water treatment plant sites. Planned and existing developments may increase pollution loads of the lake at the intake point and may in the long run deprive the facilities of land for future expansion. This could pose significant challenges to the water supply provider if the steady growth of population of Kisumu city is to be considered. Flushing of sludge from the water treatment plant into Lake Victoria pollutes the lake water and should be addressed. More importantly, the design of the treatment plant should take into consideration need for sludge drying beds for sustainable management of sludge from the treatment process. It was also noted during this study that large volume of water is lost during sludge removal and it is important to note that raw water is pumped from the lake and any loss of water is loss of energy cost incurred in the pumping of water. This cost in normally passed on to the consumer.

12.1.3 Anticipated environmental and social impacts

Significant environmental and social impacts are not anticipated from construction and operation of the proposed project. This is attributed to the fact that most of the proposed activities will be carried out within the boundaries of existing structures (in situ). Analysis of the anticipated adverse impacts revealed that most of the impacts are low in significance and can be adequately mitigated through implementation of the recommended mitigation measures contained elsewhere in this Project Report. Monitoring of progress with regard to implementation of these mitigation measures will be implemented by the Project Proponent to ensure sustainable coexistence of the project and neighbouring populations and land uses.

12.1.4 Project benefits

The project will result in better access to safe drinking water leading to improved standard of living and changes in exposure to both communicable and non-communicable diseases. Implementation of the project will promote a more sustainable use of resources with improvements in the infrastructure to reduce losses and introduction of better water treatment technologies.

12.2 RECOMMENDATIONS

A number of measures for sustainable implementation of the proposed project and associated infrastructure are contained in Chapter 9 that deals with Environmental and Social Management Plan (ESMP). The Project proponent is advised to implement these additional recommendations to ensure sustainable coexistence of the project and neighbouring populations and land uses.

12.2.1 Implement the project as proposed

From field survey and public consultation, it was noted that the proposed project will not lead to adverse environmental and social impacts to the neighbouring populations and land uses. Those consulted are also supportive of the project as they did not associate it with significant environmental and social impacts. Rehabilitation of intake work should involve harmonization of cross connections of pipes and pumps at the intake works to ensure efficiency of pumping of water. Water treatment process should be upgraded to ensure proper treatment of microorganisms and harmful chemicals that may be present in small amounts in the raw water. Sludge drying bed should be constructed for purposes of drying sludge emanating from the treatment works. The dried sludge should be disposed of in compliance with existing rules and regulations.

12.2.2 Suspend approval of developments

Development execution within the vicinity of raw water intake and water treatment plant should be suspended. A buffer zone should be created around the intake and treatment facilities as a way of managing land use conflicts. Developments next to Raw Water Intake contribute to increase in pollution load of Lake Victoria and therefore straining treatment capacity of the plant while developments around the treatment plant deprive the facility of land for expansion. Developments also block access for project infrastructure including pipelines to the treatment plant.

12.2.3 Carry out survey of the Water Treatment Plant land

The extent of the land set aside for water treatment works should be established based on the original Title Deed. Once this is done, the Project Proponent should carry out survey of the area and fence off all the land originally allocated for purposes of water treatment plant. Titles of those who have encroached on the land should be revoked.

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ANNEXES

Annex 1: Sample Survey Questionnaire Administered

Annex 2: Minutes of Public Meeting

Annex 3: List of Public Meeting Attendees

Annex 4: List of Persons consulted during ESIA study

Annex 5: Consolidated List of Persons consulted

Annex 6: NEMA Licence of ESIA Expert

Annex 7: Curriculum Vitae of Key Personnel

Annex 8: Approval Letter for Terms of Reference