ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT

FOR THE PROPOSED FLOOD CONTROL AND RIPARIAN MANAGEMENT OF KIBAGARE RIVER ADJACENT TO PREMIER SCHOOL AND CITY PARK IN PARKLANDS, NAIROBI CITY COUNTY.

PROPONENTS

PREMIER ACADEMY CHARITABLE TRUST

P.O BOX 39513-00623

NAIROBI

ENVIRONMENTAL CONSULTANTS	
Firm **Katrina Management Consultants Limited**	**Reg No.** 1695

AUGUST 2024

CERTIFICATION

The report has been done with reasonable skills, care and diligence in accordance with the Environmental management and Co-ordination Act, 1999 (amended 2015) and the Environmental Impact Assessment and Audit Regulations, 2003.

We certify that the particulars given in this report are correct to the best of our knowledge.

Firm EIA ……*Katrina Management Consultants*……

NEMA REGISTRATION certificate No……*1695*……

Address……*P.O.BOX …67688-00200*……

Signature ……Date……

PROPONENT

PREMIER ACADEMY CHARITABLE TRUST

P.O BOX 39513-00623

NAIROBI

Signature ……Date……

ACRONYMS

DOHSS	Department of Occupational Health & Safety Services
ESIA	Environmental and Social Impact Assessment
EMCA	Environmental Management Coordination Act
ESMP	Environmental and Social Management Plan
GOK	Government of Kenya
Ha	Hectare
KM	Kilometers
KNCHR	Kenya National Commission of Human Rights
KPLC	Kenya Power and Lighting Company
KURA	Kenya Urban Roads Authority
NCC	Nairobi City County
NCWSC	Nairobi City Water and Sewerage Company
PPE	Personal Protective Equipment
TOR	Terms of Reference
WRA	Water Resources Authority
SWM	Solid Waste Management
OHS	Occupational Health and Safety
NCG	Nairobi County Government

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NON-TECHNICAL SUMMARY

Background

Environmental and Social Impact Assessment is a tool for environmental conservation and has been identified as a key component in new project implementation. Early identification and mitigation of possible development impacts to the environment should be considered to enhance and promote sustainability.

According to the legal notice 31 of 30th April 2019, amendment of the second schedule of EMCA no. 8 of 1999 the projects are categorized as low risk, medium risk and high risk according to their potential impacts to the environment.

Screening of the proposed project was done and according to the classification described in the above-mentioned legislation, the project is categorized as a High risk project. A scoping exercise was therefore done and acknowledged that project's potential impact on the natural environment and human environment are significant but can be addressed and mitigated as described in this ESIA report.

Floods are a natural event that may cause extensive damages to both the surroundings and people's lives and property, therefore there is need for strong mitigation and management measures. The riparian zones are essential in mitigating floods while supporting diverse vegetation and animals.

Preserving ecological balance and protecting human settlements is important in the field of environmental management through effective flood control as well as riparian management. Flood control and riparian management is essential for safeguarding communities, ecosystems, and economies from the impacts of flooding while promoting sustainable use of natural resources.

Effective riparian management encourages sustainable land use practices that balance human needs with environmental conservation. This includes preserving natural floodplains, preventing erosion, and promoting vegetation that stabilizes riverbanks and reduces sedimentation.

Project Location

The proposed project location is located on Kibagare river Adjacent to Premier School and City Park Nairobi County The total area is approximately 450 meters, on coordinates 1016'03.4"S 36049'25.2E

Land use character

The neighboring area is predominantly commercial area with premises such as Premier School with social amenities Like the BAPS temple the Sikh union Club and City Park.

Project Description

In line with the above, the Proponent has proposed to carry out Flood Control and Riparian Management a distance of 450 meters on Kibarage River Adjacent to Premier School and City Park Nairobi County.

Scope of the Assessment

The scope of the assessment covers the project life cycle from planning, construction, occupation/operation to decommissioning. The output of this assessment is an ESIA study report for submission to NEMA to inform licensing of the project.

Terms of reference (TOR)

The consultant on behalf of the proponent conducted the study by incorporating but not limited to the following terms of reference:

- A description of the proposed location of the proposed project
- A concise description of the national and County environmental legislative and regulatory framework.
- Description of the baseline information, and any other relevant information related to the project.
- The objectives of the proposed project.
- The technology, procedures and processes to be used, in the implementation of the project.
- Undertake a detailed Hydrological assessment
- The materials to be used in the construction and implementation of the project.
- The products, by-products and waste to be generated by the project.
- A description of the potentially affected environment.
- The environmental impacts of the project including the social and cultural and the direct, indirect, cumulative, irreversible, short-term and long-term impacts.
- Analysis of alternatives including project site, design and technologies.
- Climate Change vulnerability and risk assessment of the project
- An environmental and Social management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe, monitorable indicators and responsibility to implement the measures.

- Propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies.
- An identification of gaps in knowledge and uncertainties, which were encountered in compiling the information.
- Such other matters as the Authority may require.

Methodology Outline

The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, Cap. 387
- Environmental scoping that provided the key environmental issues and development of the Terms of Reference which was approved by NEMA to guide this assessment.
- Desk-top studies and interviews
- Physical inspection of the site and surrounding areas
- Baseline studies and analysis of applicable parameters
- Undertake a detailed Hydrological assessment
- Public participation and stakeholders engagements. To ensure adequate public participation in the ESIA process. Public consultation meetings were held and the information gathered was subsequently analyzed and incorporated into the ESIA report.
- Reporting.

The Outcome of Stakeholders Consultations

The purpose for carrying out public consultations was to receive feedback from various stakeholders and project affected persons (PAPs). This process also facilitated the identification of any other critical issues, which may bring conflicts and delays project implementation.

The proposed development was received with mixed reactions during the public consultation meetings. The Friends of City Park and other PAPs welcomed the initiative since it will boost the conservation efforts and help in the protection of Kibagare river. They emphasized on the need for involvement of various key government agencies including KFS, KWS and NCCG. The PAPs also proposed joint collaboration with the Friends of City Park who are currently undertaking conservation activities at the park. The PAPs independently gave their views, opinions, and suggestions.

Selection of suitable river bank stabilization alternatives

Evaluation of alternatives is an essential part of decision making. The aim is to ensure that the optimal chosen alternative is justified, cost-effective, technically feasible and acceptable. The matrix below gives a summary of this analysis:

	Techniques	Slope	Advantage	Disadvantage	Relative cost
1	Vegetative Plantings	Maximum slope 2:1	Quick to install. A soft installation and can be combined to be used in conjunction with other practices especially where river currents exhibit higher stresses.	May be dislodged by high water levels prior to vegetation establishment	Relatively low cost.
2	Coir Fabric	Maximum slope 3:1	Geotextiles made from coir are durable, absorb water, resist sunlight, facilitate seed germination, and are 100% biodegradable. These blankets have high strength retention and a slow rate of degradation meaning they last for several years in field applications.	Dust, high salt content, biosecurity threats,	Relatively high cost.
3	Constructed Bankfull Bench	Maximum slope 2:1	Can be used when low vertical walls are needed. Vegetation and live staking can be incorporated. Provide good trout habitat.	Not appropriate for long stretches.	Relatively low cost

4	Rootwad Revetments	Maximum slope 3:1	Potential for habitat enhancement. Where appropriate, rootwads can be combined with soil bioengineering systems and vegetative plantings. Provides protection against ice ridges.	Requires use of heavy equipment and creates large areas of disturbance. Root Wads should not be located near swimming areas or public access areas as they may pose a danger to swimmers when currents are stronger.	Relatively low cost
5	Compartmentalized Placed Fill	Maximum slope 1:1	Creates a permanent soft armor solution without the use of rock, concrete or wire mesh. Provides immediate erosion control and slope stabilization even before vegetation exists. Can accommodate steeper slopes with no limitation on height. Limitless native species vegetation options. The system is water permeable minimizing hydrostatic pressure. Lower transportation and equipment costs. Site materials (soil/fill) can	Requires a considerable amount of soil/fill material. Needs to be reinforced for walls over 3 feet	Relatively low cost

			be reutilized to fill geotextile bags.		
6	Log Vane/Rock Vane	Maximum slope 3:1	Provide in stream habitat structure. Deflect flows away from the bank and scour pools. Require engineering.	Can be complex to design and install. May have significant impacts downstream from the rock barb. Rock must be large enough, so it doesn't move. Rock that is placed at a low elevation or on rivers with large water level fluctuations may not work during high water stages	Relatively high cost
7	Articulated Concrete	Maximum slope 1:1	With proper engineering block walls can achieve greater heights by reinforcing the soils. Retaining walls can be used in steep areas where access to the water's edge is necessary.	Creates near vertical banks. Most retaining walls are not able to have vegetation incorporated except at the top. Timber walls need to be environmentally sensitive.	Relatively low cost
8	Rock Riprap	Maximum slope 2:1	Can be live-staked to allow vegetation to establish. Has structural flexibility which allows it	Requires large machinery to install. Rock may be broken up or dislodged in areas	Relatively high cost

			to react to changes in the slope.	with frequent ice heaves.	
9	Articulated Concrete Block Revetment	Maximum slope 1:1	Can withstand higher shear stress	Vegetation growth is restricted by the sizes of the cell openings and by the disconnection caused by the cell walls.	Relatively high installation cost
10	Gabions	Maximum slope 1:1	Useful on steep slopes where grading is not possible. Can withstand higher shear stress than individual rocks. The use of live stakes will help to bind the gabions to the riverbank over time.	Streambed material can abrade wire baskets and cause failure.	Relatively high installation cost

Due to the level of erosion that has taken place in this section resulting into a very steep slope, natural riverbank stabilization techniques are not suitable as a primary solution. Therefore, bioengineering techniques are recommended for the initial action to stabilizing the riverbank. These techniques include articulated concrete, articulated concrete block revetment, rock riprap or gabions. According to the detailed hydrological assessment *(Annex 1),* among the mentioned bioengineering techniques, Gabions offer the best intervention for a strong and permanent solution.

Anticipated Environmental and Social Impacts

As with any other physical development, both positive and negative impacts are anticipated to arise from the proposed project, during the construction phase, operation phase as well as the decommissioning phase. In general, the following positive and negative impacts are expected to be associated with the proposed project.

Positive Impacts

- Creation of employment opportunities
- Flood control
- Improved local security

Possible negative impacts	Mitigation measures
Impacts on riparian reserve, River Quality and quantity	• Demarcation of the River riparian reserve will be informed by specialized hydrological study and this will be based on highest recorded flood level. Baseline riparian flora and fauna, water quality and quantity parameters will be determined to inform protection and enhancement.
Soil erosion and degeneration during construction period,	• Channel storm water through drains, set up measures to ensure maximum infiltration of rain water into the ground, harness rain water for re-use within the proposed development.
Noise and vibration caused by heavy trucks, and construction machinery.	• Use of silenced machines during construction, restrict construction activities to day time and proper servicing of equipment.
Traffic congestion and accidents,	• Plan movement of vehicles as will be guided by the Traffic Impact Assessment.
Safety and Health of employees arising from exposure to mechanical, physical, chemical, ergonomic and psychological hazards inherent in the project development activities.	• Adherence to the provisions of the occupational Safety and Health Act 2007 and enabling subsidiary regulations
Social Vices and spread of diseases due to an increase in the population and introduction of workers and a new population to the area.	• Ensure the contractor has a register of the workers and they have attires that can be used to distinguish them from the local residents. The contractor should also provide protection and provide sex education to the workers.
Potential conflict with the squatters occupying city park	• Notification, Engagement and Effective Grievance Redress Mechanism (GRM) to be in place in liaison

	with the NCC, the National Police Service and the Kenya National Commission on Human Rights (KNCHR).
Disruption of wildlife	• Work hand in hand with KWS and NCC to ensure the monkeys and other wildlife around city park are not affected by the proposed works. • Enhancement of riparian vegetation will also improve on the wildlife habitat within the park.
Insecurity	• Work with the National Police Service, local administration, residents' association and the *Nyumba Kumi* initiatives to enhance security during and after the project implementation.
Climate Change vulnerability and risk assessment of the project	• Climate change Mitigation and adaptation-a number of measures will incorporate to cope and adapt to climate change risks. For example, enhancement of riparian vegetation incorporating landscaping programme to reduce urban heat island phenomenon. • Design of Climate smart infrastructure to be installed and avoid climate sensitive infrastructure. • Employ other institutional, behavioral and nature-based adaption actions. • Climate Resilience- Use native and climate resilient plant species in the riparian restoration to ensure sustainability of the vegetation. • This can also include administrative (awareness among the stakeholders) strategies to be implemented.

Environmental and Social Management and Monitoring Plan (ESMP)

There is an Environmental and Social Management and Monitoring Plan (ESMP) at the end of this report. This plan ensures that environmental and social impacts are identified and mitigated during all phases of the project. The plan prescribes the recommended mitigation measures, the responsibility for the actions, the time frame/the period for the actions, the cost of undertaking the mitigation and the monitorable indicators.

Recommendations and conclusion

The proposed project will contribute to significant positive impacts in ensuring flood control and riparian management. It is equally evident that, although the project will contribute to various positive impacts, some negative impacts are inevitable and the purpose of conducting this study is to outline measures to mitigate them or where possible eradicate them completely.

It is our informed recommendation that the proponent be allowed to proceed with the implementation of the proposed project provided the outlined mitigation measures in this report are adhered to and the Environmental and Social Management Plan (ESMP) is implemented effectively.

An initial environmental audit will also be carried out within a period of 12 months after installation to check compliance of the project to the ESMP, set policies, standards and laws. The proponent is further advised to contract licensed experts to undertake periodic Environmental, Health and Safety Monitoring.

1. INTRODUCTION

It is the Kenya Government's policy commitment to ensure a balanced development approach in its efforts at promoting socio-economic development and the management of natural resources and environmental quality. Emphasis has been stressed on the need for the inclusion of environmental considerations as a required factor in decision making at the planning stage of all major development projects.

The Kenya Government policy on all new project, programmes or activities requires that an environmental and social impact assessment is carried out at the planning stages of the proposed project to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of the proposed project. The scope of this ESIA study report, therefore include:

- The baseline environmental conditions of the area,
- Description of the proposed project,
- Provisions of the relevant environmental laws,
- Identification and discussion of any adverse impacts to the environment anticipated from the proposed project,
- Appropriate mitigation measures,
- Provision of an environmental management plan outline.

The overall objective of the study report is to ensure that all environmental concerns are integrated in all the development activities of the proposed flood control and riparian management project development project in order to enhance sustainable development. Specifically the objectives are:

- To identify potential environmental impacts, both direct and in direct.
- To assess the significance of the impacts
- To assess the relative importance of the impacts of relative plans designs, and sites
- To propose preventive mitigation and compensative measures for the significant negative impacts of the project on the environment.
- To generate baseline data for monitoring and evaluation of how well the mitigating measures are being implemented during the project cycle.
- To present information on impact of alternative.
- To present the results of the EIA that can guide informed decision making and
- To prepare EMP for the proposed project and decommissioning plan.

It is stipulated in EMCA 1999 (amended 2015) that any form of development such as the proposed project is likely to impact the site and the surrounding environment hence, before commencement of any work, an Environmental and social Impact Assessment should be

undertaken in compliance with the principal environmental Act and Environmental Impact Assessment/Audit Regulations 2003.

The main objective of the assignment was to assist the proponent to prepare ESIA Study report for the proposed works to ensure that the proposed project takes into consideration appropriate measures to mitigate against identified adverse impacts to the environment. The project report identified existing and potential environmental impacts and the issues of concern that interested and/or affected parties raised about the development. The associated prevention and mitigation measures for the proposed projects negative impacts are outlined in the environmental and social Management Plan (ESMP) proposed.

The consultant on behalf of the proponent conducted the study by incorporating but not limited to the following terms of reference:

- The description proposed location of the proposed works and its associated infrastructure.
- A concise description of the national and County environmental legislative and regulatory framework.
- Description of the baseline information, and any other relevant information related to the project.
- The objectives of the proposed project.
- The technology, procedures and processes to be used, in the implementation of the project.
- The materials to be used in the construction and implementation of the project.
- The products, by-products and waste to be generated by the project.
- A description of the potentially affected environment.
- The environmental impacts of the project including the social and cultural and the direct, indirect, cumulative, irreversible, short-term and long-term impacts.
- Analysis of alternatives including project site, design and technologies.
- Climate Change vulnerability and risk assessment of the project
- An environmental and Social management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures and monitorable indicators.
- Propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies.
- An identification of gaps in knowledge and uncertainties, which were encountered in compiling the information.
- Such other matters as the Authority may require.

1.2: Methodology outline

The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring an ESIA study under schedule 2 of EMCA, 1999(amended 2015)
- Environmental scoping that provided the key environmental issues
- Desktop studies and interviews
- Physical inspection of the site and surrounding areas to inform the baseline information and data
- Public participation and stakeholders' engagements. To ensure adequate public participation in the ESIA process, public consultations were held and information gathered was subsequently analyzed and incorporated into the ESIA study report.
- Reporting.

1.2.1: Environmental screening

The screening process was applied to determine whether a full study was required and what level of assessment was necessary. This was done in reference to requirements of the principal environmental legislation and specifically the second schedule. Issues considered included the physical location, sensitive issues and nature of anticipated impact of the proposed project.

1.2.2: Environmental scoping

The scoping process narrowed down the project report to the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, social and economic aspects.

1.2.3: Desktop study

The study report included documentary review on the nature of the proposed activities, project documents, designs, relevant policy and legislative framework as well as the environmental setting of the project site area among others. It also included discussions with the proponent, stakeholders as well as consultation with neighbours.

1.2.4: Site assessment and public participation

Field visits were meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. To ensure adequate public participation in the ESIA process, public consultation meetings were held and the information gathered was subsequently analyzed and incorporated into the ESIA study.

1.2.5: Reporting

In addition to constant briefing of the client, this ESIA study report will be presented for submission to NEMA as required by law.

2. PROJECT DESCRIPTION

2.1 Location of the Project

The proposed project location is located on Kibagare river Adjacent to Premier School and City Park Nairobi County The total area is approximately 450 meters, on coordinates $1^0$16’03.4”S $36^0$49’25.2E

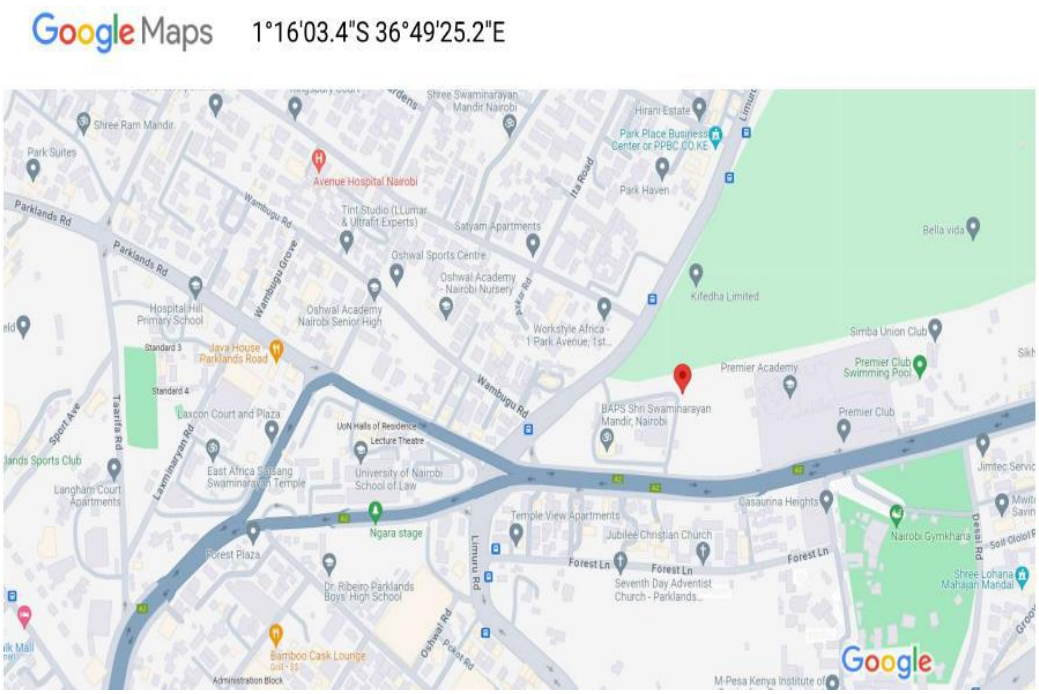

Figure 2.1: Geographical location of the proposed project site.

The proponent’s objective is ***to carry out Flood Control and Riparian Management a distance of 450 meters on Kibarage River Adjacent to Premier School and City Park Nairobi County.***

Figure 2.2 (a) and (b) Physical location of the proposed project site

Project's surrounding

The neighboring area is predominantly commercial premises such as Premier School with social amenities Like the BAPS temple the Sikh union Club and City Park.

Figure 2.3 *BAPS temple*

Figure 2.3 a section of City park

2.3 The Project Site

The river in focus is Kibagare river, a tributary of Mathare River stretching from $1^0$16'3.47"S, $36^0$49'24.96"E to $1^0$16'1.22"S, $36^0$49'36.06"E covering a length of approximately 400 meters on both banks. The Constitution of Kenya considers all rivers, lakes and other water bodies, the riparian land (the land between their high and low water marks) as public land that is under the jurisdiction of the Government of Kenya (GOK) held in trust on behalf of the citizens.

2.4 Description of the project's construction activities

2.4.1 Pre construction investigations

This starts with the thorough investigations of the site biological and physical resources in order to minimize any unforeseen adverse impacts during the project cycle. Critical to this is the hydrological assessment, hydrogeological surveys, soil sampling and analysis and the general site planning and riparian markings.

2.4.2 Site preparation works

The proposed project site will be prepared for construction. This will involve excavation works and transportation of construction materials.

This will be undertaken in a phased approach to mitigate soil erosion. Due to the nature of the proposed project the engineers will utilize human labour where necessary to limit disturbance on the fragile river ecosystem.

2.4.3 Sourcing, Transportation and Storage of materials

Materials will be stored on site. Bulky materials such as stones, ballast, sand and steel will be carefully piled at designated areas away from the riparian land. To avoid piling large quantities of materials on site, the proponent will order bulky materials such as stones in quotas. Greater emphasis will be laid on procurement of building materials from within the local area as this will make both economic and environmental advantage as it will reduce the negative impacts of transportation.

Furthermore, selection of the transporter will be determined by their environmental credentials for instance, the materials sites having the requisite environmental licensing.

2.4.4 Masonry, concrete work and related activities

Riverbank stabilization using Gabion technique requires geotechnical investigation to ascertain the geological stability of the area and guide the structural design for the implementation.

There are five major steps of work involved in gabion structure construction:

- The foundation preparation.
- The assembly, or set-up, of the gabions.
- Placement of the gabions into the proposed location.
- Placing the rock fill in the gabions
- Closing the gabions, backfilling, and finishing.

On any given project all four of these operations could be occurring simultaneously. It is the responsibility of the contractor to ensure that each is being performed properly. To accomplish this task the contractor must have some background in the recommended methods of handling the gabion material during each of these phases.

2.5 Description of the project's operational activities

2.5.1 Monitoring:

- Regular inspections will be conducted to monitor the performance of the gabion structures and identify any signs of wear, damage, or displacement.
- Monitoring will also include assessments of water flow patterns, soil stability, and vegetation growth around the gabions.

2.5.2 **Maintenance**:

- Maintenance activities will be carried out as needed, including the repair or replacement of damaged gabions, reinforcement of weak areas, and removal of debris that may obstruct water flow.
- Maintenance schedules will be developed based on seasonal variations in water flow and weather conditions.

2.5.3 **Post-Construction Site Restoration**:

- Upon completion of the construction, the site will be restored to its natural state as much as possible. This includes the removal of temporary structures, clean-up of any construction debris, and re-vegetation of disturbed areas.
- The project will also include community engagement activities to educate local residents on the importance of flood control measures and how they can contribute to maintaining the gabion structures.

2.6 Decommissioning Phase

Decommissioning is here taken to mean that the flood control measures cease to operate optimally. Under such circumstance, the proponent will be expected to adhere to the relevant legislation applicable to such an undertaking in the laws of Kenya. The decommissioning shall be undertaken through a number of steps and measures to rehabilitate the site to its initial status. This will involve analysis of sustainable alternative uses of the site that is compatible to the surrounding area.

An environmental and social impact assessment shall be commissioned to advice the proponent on the environmental impacts with respect to the identified new use.

3. BASELINE INFORMATION OF THE STUDY AREA

3.1 Introduction

The project site is located along Limuru road on Kibagare river in Westlands Sub County of Nairobi City County. The neighboring area is occupied mainly by commercial premises and social amenities.

3.2 Climate

The project area enjoys moderate cool climatic conditions. The altitude makes for some chilly evenings, especially in the June-July season when temperature can drop less than 10ºC. The period between December and March is the sunniest and warmest with temperatures averaging the mid-twenties during the day. The mean annual temperature is 17°C and the mean daily maximum and minimum are 23^{o}C and 12^{o}C, respectively. The climatic condition of the area highly influences the land use patterns, levels of productivity and general development decisions of the area.

3.3 Humidity

Due to Nairobi's location just south of the equator in combination with humid air pumped in from the Indian Ocean, the humidity values for each day are generally on the higher end. This is not to say that values are always high, since the easterly winds coming off the Indian Ocean tend to keep the temperatures standard throughout the country; therefore the "warm sticky" feeling is usually not associated with Nairobi as much as one would think. In the summer to autumn months of January to April, relative humidity values have been known to plummet to anywhere from 10% to 20%. The typical day, humidity-wise, starts off with nearly saturated in the morning hours, and steadily decreases throughout the remainder of the day.

3.4 Infrastructure and Transport

Nairobi city is well served with good communication and transport network such as air, road, and railway. The project site is centrally located to serve the prospective residents with easy access to Bus stations and the road access within an easy reach to the city center. The proposed project site is accessible from Limuru road. Other nearby roads include Wangari Mathai road and Thika Road.

Other basic infrastructural services include Solid Waste Management (SWM) system; Water and Sewerage Systems; Drainage and flood protection; Mass transportation; Electric installations; and telecommunications.

Due to rapid urban growth, provision of these basic infrastructure for all has become an important concern for development planners in the City.

3.6 Biological Diversity

- **Flora**

There is a rich composition of natural vegetation comprising of indigenous forest and several endemic plant species e.g. white *jacaranda tree*, a number of *lianas tree* species, *Aloe ballyi* known as the tree aloe, *Borassus aethiopum* among other species.

- **Fauna**

There is a rich diversity of animals including monkeys, birds, reptile and abundant insect life with a diverse range of bees.

3.7 Demography

Nairobi City is a cosmopolitan area. It records one of the highest urban population densities in the country. According to the Kenya Population and housing census 2019, the City recorded a population of 4.3million inhabitants. The current population of Nairobi is approximated to be 4.75 million with the population density of 6748/KM^2. The males are estimated at 2,373,354 while the females are 2,376,702 with an annual population change of 2% (Central Bureau of Statistics 2019).

3.8 Economic Activities

The major economic activities in Nairobi include businesses, both informal and formal. Some of the investments in the city are industries, residential developments and office complexes. The city also is a home of a number of international UN organizations for example United Nations Environmental Programme (UNEP) Agency. Due to its population and diversity, Nairobi provides numerous opportunities for trade at various scales.

4. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Environmental and Social Impact Assessment is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the principal Environmental Management and Coordination Act (EMCA) No. 8 of 1999, second schedule 9 (I), and Environmental (Impact Assessment and Audit) Regulation, 2003, both new and old projects must undergo Environmental Impact assessment and Audits. The report of the same must be submitted to the National Environment Management Authority (NEMA) for approval and issuance of the relevant certificates.

There is a growing concern in Kenya and at global level that many forms of development activities cause damage to the environment. Development activities have the potential to adversely affect the natural resources upon which the economy is dependent. Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of developmental activities. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound.

4.1 Principles of international environmental laws

4.1.1 Sustainability

The principle of sustainability requires that natural resources should be utilized in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. It strives for equity in the allocation of the benefits of development and decries short-term resource exploitation which does not consider the long-term costs of such exploitation.

4.1.2 Principle of intergenerational equity

The principle of sustainability should be examined together with that of intergenerational equity, which focuses on future generations as a rightful beneficiary of environmental protection. Essentially, the principle of intergenerational equity advocates fairness, so that present generations do not leave future generations worse off by the choices they make today regarding development. Its implementation requires the utilization of natural resources in a sustainable manner while avoiding irreversible environmental damage.

4.1.3 Principle of prevention

The principle of prevention states that protection of the environment is best achieved by preventing environmental harm in the first place rather than relying on remedies or compensation for such harm after it has occurred. The reasoning behind this principle is that prevention is less costly than allowing environmental damage to occur and then taking mitigation measures.

4.1.4 Precautionary principle

The precautionary principle recognizes the limitations of science, as it is not always able to accurately predict the likely environmental impacts of resource utilization. It calls for precaution in the making of environmental decisions where there is scientific uncertainty.

Accordingly, it is closely related to the principle of prevention and can be viewed as the application of the principle of prevention where the scientific understanding of a specific environmental threat is not complete. The precautionary principle thus requires that all reasonable measures must be taken to prevent the possible deleterious environmental consequences of development activities. Further, it demands that scientific uncertainty should not be used as a reason for not taking cost-effective measures to prevent environmental harm.

4.1.5 Polluter pays principle

The polluter pays principle requires that polluters of natural resources should bear the full environmental and social costs of their activities. It seeks to internalise environmental externalities by ensuring that the full environmental and social costs of resource utilization are reflected in the ultimate market price for the products of such utilization. Since environmentally harmful products will tend to cost more, this principle promotes efficient and sustainable resource allocation as consumers are likely to prefer to the cheaper less polluting substitutes of such products.

4.1.6 Principle of public participation

The principle of public participation seeks to ensure environmental democracy and requires that the public, especially local communities should participate in the environment and development decisions that affect their lives. It requires that the public should have appropriate access to information concerning the environment that is held by public authorities and should be given an opportunity to participate in decision-making processes.

4.1.7 Principle of Common but Differentiated Responsibilities (CBDR)

It recognizes that environmental issues are of common concern and recognizes each state contribution to the creation of an environmental programme and the ability of each state to prevent, reduce and control the threat.

4.2 Policy framework

4.2.1 Environmental policy

The Kenya Government's environmental policy aims at integrating environmental aspects into national development plans. The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of the human environment;
- Sustainable use of natural resources to meet the needs of the present generation while preserving their ability to meet the needs of future generations;
- Integrate environmental conservation and economic activities into the process of sustainable development;
- Meet national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth.

4.2.2 National Environmental Action Plan Framework, 2009-2013

The National Environment Action Plan Framework is the second national environmental policy after the 1994 National Environment Action Plan (NEAP). The development of NEAP is provided for by EMCA, 1999 which requires preparation of Environmental Action Plan at different levels; district, provincial, and national levels. The framework recognizes the intertwined linkages between economic growth and environment in Kenya. It highlights priority themes and activities for the country towards achieving sustainable environment.

The policy framework among others, proposes integration of environmental concerns into regional and local development plans, promotion of appropriate land uses and enforcement of EMCA, 1999 and its subsidiary and other relevant legislations. The policy framework also advocates for efficient water harvesting, storage and usage. On human settlements and infrastructure, this policy framework recognizes the associated environmental issues. These include waste management, sanitation, diseases, land use changes in conservation areas, demand for water, energy, construction materials, pollution, land degradation, biodiversity loss, land and housing tenure, urban planning and design and electronic wastes.

4.2.3 The National Water Policy 2021

The overall goal of the policy is to guide the achievement of sustainable management, development and use of water resources in the country with the aim of providing a framework that is dynamic, innovative and effective reengineering of the water sector.

The policy provides for among others, Water Resources Management. This includes promotion of an inclusive and integrated approach to the management of water resources

by ensuring measures are put in place for water resource management planning, water quality management, catchment protection and conservation, the development and application of appropriate technology and monitoring and information systems. It will also promote sustainable utilization of water resources.

4.2.4 The Occupational safety and Health Policy

This Policy lays emphasis on continual development and implementation of the Occupational Safety and Health systems and programs to reduce incidences of work related accidents and diseases. In addition, it seeks to offer equitable compensation to those who suffer physical injuries and contract occupational diseases. The Policy addresses the current challenges, gaps and future development of safety and health systems and programs in the country. It promotes basic principles of assessing occupational risks or hazards; combating occupational risks or hazards at source; and developing a national preventative safety and health culture that includes information, consultation, research and training. The policy also promotes continuous improvement of occupational safety and health by integrating Kenyan national laws and regulations with Regional Protocols, ILO Conventions, ISO standards and the best practices in the world. It sets up mechanisms for resource mobilization for occupational safety and health programs and activities and provides guidance to all stakeholders in the development and implementation of occupational safety and health systems and programs. The proponent is committed to put in place occupational safety and health systems and programs to be in tandem with the national policy.

4.2.5 Sustainable Development Goals (SDGs)

Sustainable Development goals which were initiated by world leaders in 2015 as an advancement of the Millennium Development Goals (MDGs) highlights the connection between the environmental, social and economic aspects of sustainable development.

The SDGs are 17 and provides a framework for the entire international community to work together towards a common end to no poverty, no hunger, good health, quality education, gender equality, clean water and sanitation, renewable energy, economic growth, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption, climate action, blue economy, life on land, peace and justice and partnerships for the goals.

4.3 Legal framework

4.3.1 NEMA

The National Environment Management Authority (NEMA) is the National body charged with coordinating matters of implementation of policy issues relating to the environment.

This body was established under the Environmental Management and Coordination (amendment) Act (EMCA), 2015. Other departments that deal with environmental issues in the County include Water Resources Authority (WRA), National Construction Authority (NCA), County Government of Nairobi, Department of Occupational Health and safety (DOHS)among others.

Premier Charitable Trust is committed to comply with all applicable legal provisions and regulations which have been reviewed in the table below.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
The Constitution of Kenya (2010)	• Provides for the protection of the right to private property • Provides for the sound conservation and protection of ecologically sensitive areas • Gives powers to the state to regulate use of land • Right to a clean and healthy environment.	• The proponent will ensure sound protection of the environment by ensuring that no pollution occurs during the entire development phase.
Environmental Management & Coordination Act, 1999 (Amended 2015) and Subsidiary Regulations	Ensure environmental protection during project implementation. • Environmental and Social Impact Assessment study • Environmental Audit and Monitoring, Environmental Quality standards and issuance of environmental protection orders • Generation of sector related regulations • Environmental Management and Coordination (Environmental Impact Assessment and Audit) Regulations, 2003 - Waste Management Regulations - 2006 - Water Quality Regulations - 2006	• Premier Charitable Trust shall comply with EMCA and subsidiary regulations including best international practices; • The proponent shall adhere to the NEMA license conditions and the ESMP during construction and implementation phase of the proposed project.
Environmental Management and Co-ordination (Waste Management) Regulations 2006	• Provides for standards for handling, transportation and disposal of various types of wastes.	• The proponent shall contract a NEMA registered waste disposal agent to dispose appropriately its solid waste.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
Environmental (Impact Assessment and Audit) Regulations, 2003	• No proponent shall implement a project if it is likely to have a negative environmental impact; or for which an environmental impact assessment is required under the Act or these Regulations unless an environmental impact assessment has been concluded and approved in accordance with these regulations. • No licensing authority under any law in force in Kenya shall issue a license for any project for which an environmental impact assessment is required under the Act unless the applicant produces to the licensing authority a license of environmental impact assessment issued by the Authority under these Regulations	• The Proponent is carrying out the ESIA for NEMA review and licensing and shall carry successive Environmental Audits at the facility to identify new potential environmental impacts associated with the future operations of the proposed flood control and riparian management project.
Environmental Management and Coordination (Air Quality) Regulations, 2014	• Provides for ambient air quality tolerance limits. • Prohibits air pollution in a manner that exceed specified levels. • Provides for installation of air pollution control systems where pollutants emitted exceed specified limits. • Provides for the control of vehicular emissions. • Provides for prevention of dispersion of visible particulate matter or dust.	• The proponent will put in place dust control measures eg watering all active construction areas, use of dust nets and carrying out regular air quality and particulate matter analysis.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
The Public Health Act (Cap 242)	• No person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health. • It shall be the duty of every health authority to take all lawful, necessary and reasonably practicable measures for preventing or causing to be prevented or remedied all conditions liable to be injurious or dangerous to health arising from the erection or occupation of unhealthy dwellings or premises	• Housekeeping within the site shall be well maintained in all the operation areas. • Sanitary conveniences shall be provided to the employees during construction and implementation of the proposed development;
The Occupational Safety and Health Act, 2007	• Provides that every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace • Provides that before any person occupies or uses any premises as a workplace, he shall apply for the registration of the premises • Provides that sufficient and suitable sanitary conveniences for the persons working at the project site shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences; and, where persons of both sexes are or are intended to be employed (except in the case of workplaces where the only persons employed are members of the same family	• First Aid kits shall be made available on site and training on first aid done; • Provision of PPEs shall be made mandatory within the facility. • Application for site registration will be done as soon as construction commences • Safety and health committee shall be formed when the facility is operational • Safety signs shall be erected and posted as appropriate during the construction phase.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
	dwelling there), such conveniences shall afford proper separate accommodation for persons of each sex • Provides that no employee is discriminated against by virtue of:- Lodging a complaint about an unsafe condition at the workplace Being an active member of a health safety committee.	
First Aid Rules, 1977 Legal Notice No. 160	These rules provide for first-aid box content with respect to size of a workplace and under whose charge the first-aid box should be placed.	• First Aid kits shall be made available and training on first aid done; • Contacts for an ambulance or a nearby hospital facility shall be provided in the eventuality of an emergency;
Building Operations and Works of Engineering Construction Rules, 1984 Legal Notice No. 40	These rules provide for the safety, health and welfare of workers in construction sites relating to building operations and works of engineering construction undertaken by way of trade or business, or for the purpose of any industrial or commercial undertaking, and any line or siding which is used in connection therewith and for the purposes thereof. The rules apply whether the building operations and works of engineering construction undertaken by or on behalf of the	During the construction phase, the contractor will be expected to ensure safety, health and welfare of workers and all persons lawfully present at the project site.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
	Government or a public body or private developer.	
Noise Prevention and Control Rules, 2005. Legal Notice No. 25	The rules provide that 'No worker shall be exposed to noise level excess of the continuous equivalent of 90 dB(A) for more than 8 hours within any 24 hours duration'. They further provide for protection from exposure to high noise levels.	• Provision of PPEs shall be made mandatory within the facility. • Medical examinations and surveillance will be implemented at the facility • Noise measurement and survey will be done at the facility
Work Injury Benefits Act, No. 17 of 2007	This law provides for compensation to employees for work-related injuries and diseases contracted in the course employment and for connected purposes.	• The employer will have an insurance cover for the facility to cater for compensation of injuries sustained by employees while at work
The Water Act, 2016 and The Water Resources Management Rules, 2007	• Provides that a permit shall be required if the developer plans to use the riparian land for any activity	• The proponent will ensure they acquire all necessary approvals from WRA.
The County Governments Act 2012	• Enforcing protection of trees and other vegetation in urban centers • Enforce orderly development in an urban setting	• The developer will work in liaison with the County Government to ensure compliance with land use requirements within the county and obtain the necessary licenses and permits.

Legislation/Regulation/ Standard	Provisions	Compliance/Non-compliance
Employment Act 2007	• The act stipulates that no person shall use or assist any other person, in using forced labour. • No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, mental status or HIV status. • An employer shall pay his employees equal remuneration for work of equal value.	• The contractor shall be a source of employment for many workers of both gender and diverse cultural backgrounds.

5 PUBLIC PARTICIPATION

5.1 Introduction

Public consultation and participation process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated by EMCA, Cap387 section 58, on Environmental Impact Assessment for the purpose of achieving the fundamental principles of sustainable development. Therefore, the chapter describes the process undertaken in the public consultation and public participation followed to identify the key issues and impacts of the proposed development. The objective of the consultation and public participation was to:

- Disseminate and inform the stakeholders about the project with Special reference to its key components and location.
- Gather comments, suggestions and concerns of the interested and affected parties about the project.
- This process also facilitated the identification of any other critical issues, which may bring conflicts and delays project implementation.
- Incorporate the information collected in the ESIA study

In addition, the process enabled,

- The establishment of a communication channel between the general public and the team of consultants, the project proponents and the Government.
- The concerns of the stakeholders are known to the decision-making bodies at an early phase of project development.

5.2 Methodology used in public consultation

The exercise was conducted by a team of experienced registered environmental experts. The following process in carrying out the entire process involved:

- Key informant interviews and discussions
- Field surveys, photography and observations
- Public Consultation Meetings (PCMs).

5.3 Consultation outcome

The proposed development was received with mixed reactions during the public consultation meetings. The Friends of City Park and other PAPs welcomed the initiative since it will boost the conservation efforts and help in the protection of Kibagare river. They emphasized on the need for involvement of various key government agencies including KFS, KWS and NCCG. The PAPs also proposed joint collaboration with the Friends of City Park who are currently undertaking conservation activities at the park. The PAPs independently gave their views, opinions, and suggestions.

(The minutes of the public consultation meetings have been annexed to this report.)

6 POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

6.1 Introduction

The environmental baseline information and the project characteristics discussed earlier, form the basis for impact identification and evaluation. The potential impacts expected from the project could either be termed as positive, negative, direct, indirect, short-term, long-term, temporary, and permanent depending on their area of impact and their persistence in the environment. This assessment is done for all the project phase namely; Pre -construction, construction, implementation and decommissioning phases.

Project stage	Possible negative impacts	Mitigation measures
Pre-construction	Impacts on riparian reserve, River Quality and quantity	• Demarcation of the River riparian reserve will be informed by specialized hydrological study and this will be based on highest recorded flood level. Baseline riparian flora and fauna, water quality and quantity parameters will be determined to inform protection and enhancement.
	Potential conflict with the squatters occupying city park	• Notification, Engagement and Effective Grievance Redress Mechanism (GRM) to be in place in liaison with the NCC, the National Police Service and the Kenya National Commission on Human Rights (KNCHR).
	Loss of bio diversity	▪ Ensure revegetation using the appropriate species of plants. • Restrict movement within the existing walkways or paths
Construction	Soil erosion and degeneration during construction period,	• Channel storm water through drains, set up measures to ensure maximum infiltration of rain water into the ground, harness rain water for re-use within the proposed development.

	Noise and vibration caused by heavy trucks, and construction machinery.	• Use of silenced machines during construction, restrict construction activities to day time and proper servicing of equipment.
	Traffic congestion and accidents,	• Plan movement of vehicles as will be guided by the Traffic Impact Assessment.
	Safety and Health of employees arising from exposure to mechanical, physical, chemical, ergonomic and psychological hazards inherent in the project development activities.	• Adherence to the provisions of the occupational Safety and Health Act 2007 and enabling subsidiary regulations
	Social Vices and spread of diseases due to an increase in the population and introduction of workers and a new population to the area.	• Ensure the contractor has a register of the workers and they have attires that can be used to distinguish them from the local residents. The contractor should also provide protection and provide sex education to the workers.
	Disruption of wildlife	• Work hand in hand with KWS and NCC to ensure the monkeys and other wildlife around city park are not affected by the proposed works. • Enhancement of riparian vegetation will also improve on the wildlife habitat within the park.
	Insecurity	• Work with the National Police Service, local administration, residents' association and the *Nyumba Kumi* initiatives to enhance security during and after the project implementation.
Implementation	Climate Change vulnerability and risk assessment of the project	• Climate change Mitigation and adaptation-a number of measures will incorporate to cope and adapt to climate change risks. For example, enhancement of riparian vegetation incorporating landscaping programme to reduce urban heat island phenomenon. • Design of Climate smart infrastructure to be installed and

		avoid climate sensitive infrastructure. • Employ other institutional, behavioral and nature-based adaption actions. • Climate Resilience- Use native and climate resilient plant species in the riparian restoration to ensure sustainability of the vegetation. • This can also include administrative (awareness among the stakeholders) strategies to be implemented.
	Landscape and ecosystem change	▪ Once the project is completed any bare land will be re-vegetated with indigenous grass, shrubs and trees ▪ Landscaping will be done to reduce any negative impacts ▪ Only specified areas of construction will have vegetation cleared ▪ protecting the existing individual trees as much as possible ▪ A surface flow constructed wetland is necessary to safeguard the riverbank stability, water quality and security around the area.
	Potential conflict with encroachers on to the riparian land.	• Engagement and Effective Grievance Redress Mechanism (GRM) to be in place in liaison with the NCC, the National Police Service and the Kenya National Commission on Human Rights (KNCHR). • Enforcement by the relevant government agencies.
Decommissioning stage	Loss of employment opportunities	• A good phase out programme for employees should be put in place from the onset of the project.
	Exposure to Occupational hazards and accidents.	• Adherence to the provisions of the occupational Safety and Health Act 2007 and enabling subsidiary regulations

	Loss of environmental aesthetics.	▪ Ensure complete collection and disposal of wastes after demolition ▪ Landscaping the affected areas and consideration for acceptable and compatible after-use plan. ▪ Conduct periodic monitoring.

7. ANALYSIS OF PROJECT ALTERNATIVES

Evaluation of alternatives is an essential part of decision making. The aim is to ensure that the optimal chosen alternative is justified, cost-effective, technically feasible and acceptable.

Riverbank Stabilization Techniques

Discussed below are some of the effective techniques that can be implemented for riverbank protection either as a single measure or a combination of more than one measure.

Vegetative Plantings

The planting of herbaceous and woody vegetation is one of the simplest forms of stabilizing a riverbank. The plant roots help stabilize the soil and control shallow mass movement by binding soil particles and by removing moisture from the soil. The above-ground portion of the plant provides some protection of the soil surface and reduces water velocity. While vegetative plantings are incorporated into several bioengineering techniques, the techniques that primarily rely on the establishment and growth of vegetation are described as follows.

i. **Plugs:** These consist of individual rooted stems of grasses, sedges, and rushes. They are often planted along the lower portion of the bank approximately one foot below the ordinary highwater level, where they form clumps to help prevent scour in low stress areas. Plugs can be used in conjunction with other techniques, such as coir matting, compartmentalized placed fill, and vegetated geogrids.

ii. **Live stakes**: They are dormant (but live) cuttings or branches typically 2 to 3 feet in length that are inserted into the soil at or below bankfull elevation. If correctly prepared, handled, and placed, the live stake will, under suitable conditions, root and grow. Only a few species will grow well from live stakes. Those species include willows, dogwoods, and elderberry. Live stakes can be used in conjunction with other techniques, including erosion control matting.

iii. **Live fascines**: These are long bundles of live woody vegetation buried in a riverbank in shallow trenches placed parallel to the flow of the river. The plant bundles sprout and develop a root mass that will hold the soil in place and protect the bank from erosion. These cuttings are bound together in bundles that are typically 6 to 8 inches in diameter and 4 to 20 feet in length.

iv. **A brush mattress:** is a layer of live branch cuttings, placed perpendicular to the flow of the river on the bank, and held down in place with poultry netting or light gauge

wire mesh to form a "mattress" of woody material. Live stakes are often placed in between the layers of brush, and a live fascine is often placed at the toe of the bank for added protection. The mattress covers the bank and provides high resistance to Sheer stress and increased roughness, thereby reducing flow velocities. For this reason, a brush mattress is one of several techniques appropriate for outer meander bends where near-bank Sheer stress tends to be moderate to high and/or where space for excavation is limited by high banks or relatively deep pools near the banks. The live cuttings and live stakes that make up the mattress propagate riparian vegetation. Moreover, the irregular surface of the numerous branches that make up the brush mattress tends to capture sediment during flood conditions, thereby creating a substrate suitable for colonization of some native vegetation.

Regardless of the technique employed, any trees and other vegetation on the banks would need to be removed to implement the remediation/stabilization. In addition, because any future windthrow and overtopping of trees would destabilize those banks and cause severe bank erosion, only herbaceous plants and shrubs, and not trees, would be planted in connection with any bioengineering technique.

Coir Fabric Techniques

Coir fabric or coir matting is erosion control matting constructed of coconut fibers. The matting protects the banks while vegetation is established and biodegrades in about 5 years. Coir fabric is also used to construct several other bioengineering systems, including pre-vegetated mats, pre-planted coir pillow, and vegetated geogrid.

Pre-vegetated mats are coir mats that are pre-planted with sprigs or seeds and grown in a nursery to establish vegetation in the matting prior to use. The mats are placed on the bank soil in a manner similar to the placement of a sod mat. A variation of this is a pre-planted coir pillow, which is an approximately 3 feet by 8 feet by 4 inches thick coir fiber log. Because coir pillows are pre-planted, vegetation tends to become established more quickly.

Coir matting is applicable in a variety of conditions to protect banks while vegetation becomes established. This treatment can be used alone in depositional areas or on banks with low near-bank Sheer stress. This would include the inside of broad mender bends, straight reaches where the thalweg is in the center of the channel, or downstream of stable point bars. In such conditions, the bank would be graded to a low slope of 3:1 or less, covered in coir matting, and replanted with herbaceous and shrub vegetation. Coir matting may also be used on the upper bank slopes (above bankfull elevation) on banks undergoing stabilization with riprap or compartmentalized placed fill. Bank soil removal would be performed as necessary to allow implementation of these measures.

The most sophisticated use of coir matting is to construct vegetated geogrids. A vegetated geogrid consists of a wall composed of 1-foot "lifts" of compacted soil wrapped in coir fabric or geotextile (typically synthetic) fabric, with plugs, live stakes, or other plantings placed between each lift. This technique essentially replaces the riverbank with a newly constructed, reinforced wall that provides resistance to Sheer stress, while at the same time providing vegetative growth. The irregular surface created by the lifts helps to trap sediment during flood events, which in turn encourages further vegetative growth and colonization of vegetation. Because the vegetated geogrid is a wall, it can be constructed on steep slopes, thereby providing a suitable solution where it is not feasible to decrease the slope of a bank. It can also be used to protect fill slopes, which are generally more susceptible to erosion than slopes cut into in-situ soil. Some bank soil removal would be performed in association with using vegetated geogrids where vertical banks are sloped to 1:1 or greater. As an alternative to the lifts, a product known as "BioD-Blocks" can be used. This product is composed of coir fiber "blocks" tied into the bank with coir fiber matting (with layers of compacted soil placed between each course of blocks). Unlike conventional soil layer lifts, the coir block forms the face of the soil lift, which provides enhanced resistance to Sheer stress.

Constructed Bankfull Bench

The bankfull bench is a nearly flat area of variable width (but usually a minimum of 4 feet wide) constructed on a riverbank either by excavation or by the placement of fill. The bench is constructed at the bankfull elevation. The bankfull bench is designed not only to stabilize the riverbank, but also to improve the overall stability of the channel. Rivers which are within incised valleys, have bankfull flows that do not reach the floodplain. Flows greater than bankfull have increased velocities until reaching the top of bank elevation. For incised systems, conditions of bed and bank instability can lead to bank erosion. A bankfull bench attempts to address this by modifying the channel geometry into a stable form that possesses the width and depth necessary to transport the river's sediment load over time without aggrading or degrading. The overall sediment transport capacity of the channel is increased while Sheer stress to the bank is decreased.

The bankfull bench can function as a stand-alone measure, but it can also be used where any excavation, reshaping, or armoring of a riverbank occurs. It is also usually accompanied by vegetative plantings to provide added stability, particularly if fill soils are used; typically, shrubs and herbaceous vegetation would be planted on and above the bench, while only herbaceous vegetation would be planted below the bench. Vegetation on the bench increases roughness which in turn reduces flow velocities along the bank and allows for deposition of sediment.

Bankfull benches would be used on straight reaches between meander bends to help further reduce moderate Sheer stress. Benches would either be excavated into the existing bank

(requiring bank soil removal) or, where the channel is "over-wide" (i.e. wider than necessary to carry its sediment load) built out into the channel. The bank would be graded to a 2:1 slope from the toe of the bank to the bankfull elevation, the bench would be constructed, and the bank would continue at a 2:1 slope or less to the top of the bank. The bank and the bench would be covered in coir matting and planted with vegetation. Bankfull benches would also be incorporated into the reconstruction of the inside of meander bends. For example, when a point bar is rebuilt, a short bankfull bench could be constructed toward the downstream end to assist with the transition between the point bar and the downstream riffle.

Rootwad Revetments

Rootwad revetments are composed of "rootwads," which are downed trees that are buried in a riverbank with the root mass portion exposed towards the flow, and the stem or bole of the tree buried in the bank. Generally, the root system of the trees used as rootwads would be at least 3 feet in diameter. Rootwads are often placed in clusters along the outer meander bends of a river to form a protective layer against high Sheer stress impacting the riverbanks.

Rootwads are usually used in conjunction with logs or boulders to create an integrated revetment, whereby the rootwad tree is laid on top of a footer log, to provide stability and achieve the desired angle that is necessary to maximize resistance to flow. Boulders are often placed between the rootwads to minimize erosion or scour around the rootwad, and to anchor the rootwads to increase their tolerance to Sheer stress. Since rootwad revetments have the potential for scour around the structure, particularly on the upper bank above the rootwad, the placement of the rootwad clusters is usually accompanied by vegetative plantings, brush layers, or matting to help stabilize the upper bank.

When properly installed and given measures to minimize scour around the structure, rootwads can provide a high level of stability in or near high stress bends. They would be used in conjunction with other bank treatments in areas of high to moderate near bank stress. Rootwads would be particularly useful on the outside of meander bends, past the areas of highest near-bank stress, to provide a transition from harder treatments such as riprap and log vanes to a bank treatment that is softer in nature such as a bankfull bench.

Compartmentalized Placed Fill

This technique consists of placing filled bags or tubes of organic material and stone on the riverbank to armor slopes. The bags are typically built into a wall unit using either straps or a locking spike to create a stable surface. The bags are composed of a synthetic material that is filled with a planting medium. Native plants are planted between the layers or lifts of bags to promote vegetation growth. The bags break down under UV exposure and can last from 10 years to over 50 years depending upon the amount of exposure.

Compartmentalized placed fill can be used on moderately steep banks or in areas of moderate to high Sheer stress.

These areas occur in a variety of geomorphic positions, including the outside of broad meander bends, straight reaches where the thalweg is near the bank, and downstream of tight meander bends. The banks undergoing such treatment would be graded to a 2:1 slope or less, with bank soil removal as necessary. The compartmentalized placed fill would be placed from the toe of the bank to bankfull elevation. Above bankfull, the bank would be stabilized with a vegetative technique, including planting of herbaceous and shrub species.

Log Vane/Rock Vane

A vane is an in-stream structure that is used to deflect near-bank erosional forces away from unstable riverbanks. A log vane involves placement of a log with a rootwad anchored into the bank, facing upstream, and angled on a downward slope from bankfull elevation at the bank to the channel bed elevation at the end of the log. A footer consisting of a second log or boulders is placed beneath the log. Filter fabric is often placed along the footer, and the area between the log and the bank is backfilled to prevent undercutting of the vane. A rock vane is of similar geometry but constructed of large boulder sized rock.

Vanes are typically installed at the upstream end of an outer meander bend or other unstable area of moderate to high near bank stress to deflect flow away from the bank and dissipate energy. Typically, vanes would be used in series on the outside of meander bends in conjunction with other techniques such as riprap or compartmentalized placed fill. For the most part, log and rock vanes can be used interchangeably. There are some circumstances in which it is difficult to install a log vane such as when the water is too deep or the bank is too low to adequately bury and anchor the log. There may be other situations where banks are too high or steep to be suitable for use of log vanes. In these instances, rock vanes may be used rather than log vanes.

Variations of the vane are barbs or bank spurs. These are small low rock or log structures oriented upstream, extending into the stream thalweg (i.e., the deepest portion of the river) to divert flow away from an eroding bank by helping to maintain the thalweg towards the center of the channel. Usually, several stream barbs are installed in series along the outside of a meander bend They differ from log vanes in that they typically do not protrude more than a third of the way into the river channel. Barbs transfer erosive velocity away from the stream bank through interruption of currents and cross-stream flow that develop within the meander bend. Barbs have been shown to be effective at redirecting flows and inducing deposition. They are typically used on meander bends with a larger radius of curvature that do not have extremely high sheer stress, and/or in sections of the river channel that are over-wide to help maintain sediment transport.

Articulated Concrete

Articulated concrete structures are pre-cast concrete blocks consisting of three perpendicular arms that are rigidly fixed at the center. These structures are placed along a toe of slope of bank to dissipate the energy of the water against the bank and therefore reduce erosion and increase sedimentation. Voids in the matrix are often filled with soil and stone. The spacing of the articulated concrete allows for the establishment of vegetation between the blocks. The blocks will often collect coarse and fine sediment when functioning properly so that the treated banks naturally revegetate as the systems become embedded in the stream bank.

Articulated concrete may be used as an alternative to riprap in circumstances where it would not be possible to fully implement other types of bank treatment below the water line, such as when stabilization work is being performed while water is flowing in the channel. In these circumstances, a treatment incorporating articulated concrete may be used to protect the toe of the bank and prevent scour and undercutting of the bank.

Rock Riprap

Stone has long been used to provide immediate and permanent riverbank protection. One use of stone is riprap which consists of large angular rocks placed on the bank to reduce bank Sheer stress and erosion. Riprap is one of the most effective measures at the toe of a slope or unstable bank for preventing erosion. A primary advantage of riprap over vegetation is its immediate effectiveness with little to no establishment period. Riprap is typically placed on banks at a 2:1 slope but may be used on steeper bank slopes of up to 1.5:1. Stone size, shape, gradation, and density are all important design considerations.

In some situations, joint planting is combined with riprap to provide some vegetation. Joint planting refers to the insertion of plugs and/or live stakes between the rocks to encourage the growth of riparian vegetation. The planting of cuttings in riprap helps to provide longer-term stability once the vegetation becomes established.

Riprap would be used on banks that are under high near-bank Sheer stress. The bank would be graded to the selected slope (with bank soil removal as necessary) and riprap would then be placed from the toe of the bank to a maximum of bankfull elevation. Above bankfull elevation, other applicable bank treatments would be used, such as coir matting and joint plantings (where appropriate), to revegetate the banks with herbaceous and shrub vegetation.

Articulated Concrete Block Revetment

An articulated concrete block (ACB) revetment system is a matrix of interconnected concrete block units installed to provide an erosion resistant revetment. An ACB revetment system consists of concrete block units that are typically connected by geometric interlock, cables, ropes, geotextiles, or geogrids to form a mattress. The concrete mattress overlays a geotextile fabric for subsoil retention.

A variety of proprietary ACB revetment systems are available. The thickness of the blocks typically ranges from 4 to 9 inches. The blocks are cast into interlocking or noninterlocking shapes and usually are cabled into mats but can be non-cabled. The blocks may be an open cell or closed cell. Open-cell blocks allow for a greater space for soil to be placed into them or for sediment to fill in the open areas and to eventually become vegetated.

Articulated concrete block revetments are applicable in high-risk applications where no additional bank or grade movement is desired, particularly in areas of very high velocities and Sheer stresses. Its use is also advantageous in areas where reshaping of the banks is not desirable or possible.

Gabions

For a riverbank that needs a strong and permanent erosion control method, gabions might be the best choice. Gabions are large metal baskets filled with stone or concrete rubble. They're an ideal solution for areas in which a large amount of soil erosion is likely to occur. Although they're not particularly attractive, you can sink the gabions below the water line at the river. Not only does this make them nearly invisible but it also helps slow the velocity of water flow and trains the river to flow in the desired path.

Analysis of Alternatives

Evaluation of alternatives is an essential part of decision making. The aim is to

Evaluation of alternatives is an essential part of decision making. The aim is to ensure that the optimal chosen alternative is justified, cost-effective, technically feasible and acceptable. The matrix below gives a summary of this analysis:

	Techniques	Slope	Advantage	Disadvantage	Relative cost
1	Vegetative Plantings	Maximum slope 2:1	Quick to install. A soft installation and can be combined to be used in conjunction with other practices especially where river currents exhibit higher stresses.	May be dislodged by high water levels prior to vegetation establishment	Relatively low cost.
2	Coir Fabric	Maximum slope 3:1	Geotextiles made from coir are durable, absorb water, resist sunlight, facilitate seed germination, and are 100% biodegradable. These blankets have high strength retention and a slow rate of degradation meaning they last for several years in field applications.	Dust, high salt content, biosecurity threats,	Relatively high cost.
3	Constructed Bankfull Bench	Maximum slope 2:1	Can be used when low vertical walls are needed. Vegetation and live staking can be incorporated. Provide good trout habitat.	Not appropriate for long stretches.	Relatively low cost

4	Rootwad Revetments	Maximum slope 3:1	Potential for habitat enhancement. Where appropriate, rootwads can be combined with soil bioengineering systems and vegetative plantings. Provides protection against ice ridges.	Requires use of heavy equipment and creates large areas of disturbance. Root Wads should not be located near swimming areas or public access areas as they may pose a danger to swimmers when currents are stronger.	Relatively low cost
5	Compartmentalized Placed Fill	Maximum slope 1:1	Creates a permanent soft armor solution without the use of rock, concrete or wire mesh. Provides immediate erosion control and slope stabilization even before vegetation exists. Can accommodate steeper slopes with no limitation on height. Limitless native species vegetation options. The system is water permeable minimizing hydrostatic pressure. Lower transportation and equipment costs. Site materials (soil/fill) can	Requires a considerable amount of soil/fill material. Needs to be reinforced for walls over 3 feet	Relatively low cost

			be reutilized to fill geotextile bags.		
6	Log Vane/Rock Vane	Maximum slope 3:1	Provide in stream habitat structure. Deflect flows away from the bank and scour pools. Require engineering.	Can be complex to design and install. May have significant impacts downstream from the rock barb. Rock must be large enough, so it doesn't move. Rock that is placed at a low elevation or on rivers with large water level fluctuations may not work during high water stages	Relatively high cost
7	Articulated Concrete	Maximum slope 1:1	With proper engineering block walls can achieve greater heights by reinforcing the soils. Retaining walls can be used in steep areas where access to the water's edge is necessary.	Creates near vertical banks. Most retaining walls are not able to have vegetation incorporated except at the top. Timber walls need to be environmentally sensitive.	Relatively low cost
8	Rock Riprap	Maximum slope 2:1	Can be live-staked to allow vegetation to establish. Has structural flexibility which allows it	Requires large machinery to install. Rock may be broken up or dislodged in areas	Relatively high cost

			to react to changes in the slope.	with frequent ice heaves.	
9	Articulated Concrete Block Revetment	Maximum slope 1:1	Can withstand higher shear stress	Vegetation growth is restricted by the sizes of the cell openings and by the disconnection caused by the cell walls.	Relatively high installation cost
10	Gabions	Maximum slope 1:1	Useful on steep slopes where grading is not possible. Can withstand higher shear stress than individual rocks. The use of live stakes will help to bind the gabions to the riverbank over time.	Streambed material can abrade wire baskets and cause failure.	Relatively high installation cost

Due to the level of erosion that has taken place in this section resulting into a very steep slope, natural riverbank stabilization techniques are not suitable as a primary solution. Therefore, bioengineering techniques are recommended for the initial action to stabilizing the riverbank. These techniques include articulated concrete, articulated concrete block revetment, rock riprap or gabions. According to the detailed hydrological assessment *(Annex 1),* among the mentioned bioengineering techniques, Gabions offer the best intervention for a strong and permanent solution.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

Environmental monitoring is an integral part of the environmental management process. It rationally completes the process that begins with establishing the environmental baseline condition followed by carrying out the Environmental and Social Impact Assessment then Implementation of Mitigation Measures and Monitoring the success of those measures.

The Environment and Social Management Plan is an important process of ensuring project sustainability and environmental and social protection. Whereas efforts are usually made to develop mitigation measures for a proposed project, it is during the operation lifespan of the project that actual impacts are noted or experienced.

It is therefore important to integrate in the environmental and social impact assessment process, an environment monitoring and management plan that includes the monitoring of the progress of mitigation measures being implemented while also monitoring the project for any new negative impacts that were not earlier considered or anticipated.

The proponent shall ensure that the Contractor understands and implements all specified mitigation measures during the construction period. The proponent is responsible for assessing the Contractor's Environmental and Social Management Plan and internally implements the Management Plan to ensure that the Environmental and Social Impacts are monitored and managed in an environmentally and socially acceptable manner.

Monitoring systems should be set up by the Proponent during the operational phase, so that potential environmental problem areas can be detected well in advance and the appropriate remedial action carried out. The Proponent shall have a checklist of items that need to be monitored as a matter of routine or periodically over agreed intervals, as guided by the ESMP. However, socio-economic and ecological parameters can be effectively assessed over a longer time span.

8.2 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) is provided in the table below.

Environmental and Social Management Plan (ESMP)

Project stage	Possible negative impacts	Mitigation measures	RESPONSIBLE PARTY	MONITORABLE INDICATOR	BUDGETARY REQUREMENTS
Pre-construction	Impacts on riparian reserve, River Quality and quantity	• Demarcation of the River riparian reserve.	WRA & NEMA Proponent, Contractor	Valid Licenses and permits from relevant authorities. NEMA,WRA,NCCG,DOSH & NCA	100,000
	Potential conflict with the squatters occupying city park	• Notification, Engagement and Effective Grievance Redress Mechanism (GRM) to be in place.	Proponent, NCCG, National Police Service and the Kenya National Commission on Human Rights (KNCHR).	• GRM is in place • Register of complaints	20,000
	Loss of bio diversity	• Ensure revegetation using the appropriate species of plants. • Restrict movement within the existing walkways or paths	Proponent, Contractor, KFS, NCCG, Friends of City Park	• Number of trees planted • Survival rates of the planted trees • Percentage of paved area to vegetative area	20,000

Construction	Soil erosion and degeneration during construction period,	• Channel storm water through drains, set up measures to ensure maximum infiltration of rain water into the ground, harness rain water for re-use within the proposed development.	Proponent/Contractor	• Storm water drains • Area of land which has been revegetated/grassed	100,000
	Noise and vibration caused by heavy trucks, and construction machinery.	• Use of silenced machines during construction • restrict construction activities to day time • proper servicing of equipment. • Use of PPEs	Proponent/Contractor and Workers	• Number of complaints on noise pollution • Number of incidences • Availability and use of PPEs by the workers • Maintenance records for the machinery	20,000
	Traffic congestion and accidents,	• Have a traffic marshal on site.	Proponent, Contractor, Drivers	• Number of trained traffic marshals. • Number of traffic related incidents. • Traffic signage in place.	50,000

		• Put up road signage as appropriate. • Transportation of materials to site should be during off peak hours.			
	Safety and Health of employees arising from exposure to mechanical, physical, chemical, ergonomic and psychological hazards inherent in the project development activities.	• Adherence to the provisions of the occupational Safety and Health Act 2007 and enabling subsidiary regulations	Proponent, Contractor, workers	• Number of incidences reported • Workers have Safety Gear • Medical records • Have a trained First Aider on site • Emergency contacts for Hospital and Police available	20,000
	Social Vices and spread of diseases due to an increase in the population and introduction of workers	• A register of the workers in place. • Provide staff/ work attires. • provide protection from sexual	• The Proponent • Contractor • Ministry of Public Health	• Pamphlets on Health Matters • Records of disease incidences /prevalence • Awareness creation on SEA	30,000

	and a new population to the area.	exploitation and abuse (SEA).			
	Disruption of wildlife	• Work hand in hand with KWS and NCCG to ensure the monkeys and other wildlife around city park are not affected by the proposed works. • Enhancement of riparian vegetation will also improve on the wildlife habitat within the park.	Proponent, Contractor, KWS, KFS, NCCG	• Number of engagements with KWS, KFS and NCCG • Number of tree seedlings planted and their survival rates • The acreage of the protected riparian land.	100,000
	Insecurity	• Work with the National Police Service, local administration , residents' association and the *Nyumba Kumi* initiatives to enhance security during	National Police Service, local administration, residents' and Friends of City Park	• Presence of security personnel • Number of insecurity incidences	50,000

		and after the project implementation.			
Implementation	Climate Change vulnerability and risk assessment of the project	• Climate change Mitigation and adaptation-a number of measures will incorporate to cope and adapt to climate change risks. For example, enhancement of riparian vegetation incorporating landscaping programme to reduce urban heat island phenomenon. • Design of Climate smart infrastructure to be installed and avoid climate sensitive infrastructure. • Employ other institutional,	Proponent, Contractor, KFS, NCCG, Friends of City Park	• Number of trees planted • Survival rates of the planted trees • Percentage of paved area to vegetative area	Cost covered above

		behavioral and nature-based adaption actions. • Climate Resilience- Use native and climate resilient plant species in the riparian restoration to ensure sustainability of the vegetation. • This can also include administrative (awareness among the stakeholders) strategies to be implemented.			
	Landscape and ecosystem change	▪ Once the project is completed any bare land will be re-vegetated with indigenous grass, shrubs and trees ▪ Landscaping will be done to	Proponent, Contractor, KFS, NCCG, Friends of City Park	• Number of trees planted • Survival rates of the planted trees ▪ Percentage of paved area to vegetative area	Cost covered above

		reduce any negative impacts ▪ Only specified areas of construction will have vegetation cleared ▪ protecting the existing individual trees as much as possible ▪ A surface flow constructed wetland is necessary to safeguard the riverbank stability, water quality and security around the area.			
	Potential conflict with encroachers on to the riparian land.	• Engagement and Effective Grievance Redress Mechanism (GRM). • Enforcement by the relevant government agencies.	Proponent, NCCG, the National Police Service and the Kenya National Commission on Human Rights (KNCHR) and Friends of City Park.	• GRM is in place • Register of complaints	Cost covered above

Decommissioning stage	Loss of employment opportunities	• A good phase out programme for employees should be put in place from the onset of the project.	Proponent, NCCG	• Compliance with WIBA	TBD
	Exposure to Occupational hazards and accidents.	• Adherence to the provisions of the occupational Safety and Health Act 2007, WIBA 2007 and their subsidiary regulations	Proponent, DOSH	• Number of incidences reported • Workers have Safety Gear • Medical records • Have a trained First Aider on site • Emergency contacts for Hospital and Police available	TBD
	Loss of environmental aesthetics.	▪ Ensure complete collection and disposal of wastes after demolition ▪ Landscaping the affected areas and consideration for acceptable	Proponent in liaison with, NEMA, NCCG and WRA	• Provision of an approved decommissioning plan. • Provision of a decommissioning report.	TBD

		and compatible after-use plan. ▪ Conduct periodic monitoring.			
Total Cost					**510,000**

9. AN IDENTIFICATION OF GAPS IN KNOWLEDGE AND UNCERTAINTIES

During the assessment and report preparation phases, no specific gaps in knowledge or uncertainties were identified. The proponent has proactively planned to secure all required approvals from key organizations such as NEMA(National Environmental Management Authority), WRA (Water Resources Authority), KFS (Kenya Forest Services) KWS (Kenya Wildlife Services) NCCG (Nairobi City County Government), and DOSHS (Department of Occupational Safety & Health Services).

The area has rich biodiversity that the proponent has been advised to ensure they put in place measures to safe guard them in consultation with the relevant authorities.

Additionally, comprehensive mitigation measures will be implemented as guided by the ESMP to address potential adverse impacts associated with the project and ensure adherence to relevant planning, environmental and other regulatory requirements.

10 CONCLUSION AND RECOMMENDATIONS

The Premier Academy is located in an area classified as of low flood risk. Riverbank erosion is affecting the institution fence neighboring the stream and exposing the school property to security challenges. Therefore, the institution needs to implement an integrated riverbank stabilization and fencing. On the opposite side of the stream, a surface flow constructed wetland is necessary, and can be implemented together with the institution managing the city park.

Due to the level of erosion that has taken place at the project site resulting into a very steep slope, natural riverbank stabilization techniques are not suitable as a primary solution. Therefore, bioengineering techniques are recommended for the initial action to stabilizing the riverbank. These techniques include articulated concrete, articulated concrete block revetment, rock riprap or gabions. According to the detailed hydrological assessment *(Annex 1),* among the mentioned bioengineering techniques, Gabions offer the best intervention for a strong and permanent solution.

It is our recommendation that the proponent be allowed to implement the project provided the mitigation measures outlined in the report are adhered to, and the proponent complies with the conditions of approval of this undertaking.

REFERENCES

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The Occupational Safety and Health Act, 2007, Government Printers, Nairobi

Annexes

Annex 1: Detailed Hydrological Assessment

Annex 2: Ownership Documents

Annex 3: Questionnaires

Annex 4: Change of User

Annex 5: BQ

Annex 6: Experts Licenses

Annex 7: PIN & Incorporation Certificate